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**A BIOLOGICAL INVENTORY OF THE WARSAW CAVES
AREA OF NATURAL AND SCIENTIFIC INTEREST,
PETERBOROUGH COUNTY, ONTARIO**

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July 1990

Parks and Recreational Areas Section,
Ontario Ministry of Natural Resources
Central Region, Aurora



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ABSTRACT

The Warsaw Caves ANSI offers a diversity of karst landscape features - limestone plains, solution holes, underground channels, limestone cliffs - at a site thinly covered by glacial moraine. The unusual landscape complex is enhanced by the presence of a former postglacial spillway which supports relict flora, such as the provincially significant Smooth Woodsia (*Woodsia glabella*) fern. It is both rare and biogeographically important in southern Ontario. The cliff and ridge complex along the spillway (now occupied by the Indian River) constitutes the life science and aesthetic highlight of the ANSI.

Limestone plains on either side of the Indian River support upland coniferous and mixed successional forests dominated by White Cedar, White Pine and Balsam Fir. These forests are representative of limestone plain upland forests in the Central Region.

An area of Sugar Maple forest, some mature (ca. 140 years of age) and the rest submature (ca. 75 years of age) dominates the deeper sandy loam deposits in the central portion of the ANSI.

Additional investigations of the caves as bat roosts are suggested, as are measures required to ensure the protection of the Smooth Woodsia stand from destruction by residential development. It is recommended that the ANSI lands within the Warsaw Caves Conservation Area be managed, as far as possible, as nature reserve lands.

The site contains a provincially significant karst and spillway vegetation-landform complex as well as representative coniferous and deciduous upland forest and valley slopes. The entire site is considered by Ontario Ministry of Natural Resources Central Region to constitute a provincially significant ANSI.

PREFACE

A detailed life science inventory of the Warsaw Caves Area of Natural and Scientific Interest (ANSI) was undertaken in the late summer of 1989. The inventory was required in order to provide up-to-date inventory and assessment data on the significant resources of the study area and to offer options and directions for ecologically sensitive management of these resources.

The identification of ANSIs often has resulted from the provincial survey of life science and earth science natural areas undertaken by the Parks and Recreational Areas Program of the Ontario Ministry of Natural Resources in connection with park system planning. The mandate of these surveys stems from the protection objective of the Ontario Provincial Parks Policy (1978) which is "to protect provincially significant elements of the natural and cultural landscape of Ontario".

The overall objective of the natural areas survey is to identify a series of ecological areas which comprises the spectrum of natural landscapes, environments and biotic communities in Ontario. This objective issues from a cabinet - endorsed guideline of the 1978 Provincial Parks Policy which recognizes the role of provincial parks in protecting "a system of features representative of Ontario's life science history and diversity". The Warsaw Caves ANSI is one of these areas.

Although the Warsaw Caves themselves have long been considered an interesting landscape feature and the general area has been the subject of life science investigations since the first of the famous "Lakefield trio" (Suzanna Moodie, Cartherine Parr Traill and John Langton) settled nearby in the early 19th century, the immediate area of the ANSI has been poorly studied. This study, then, also provides the opportunity of documenting the life science features of a poorly known area of Central Region.

The study was undertaken under the supervision of Central Region Ecologist John L. Riley, who provided the background file data, base maps and several items of important literature as well as handling the administrative requirements. Ontario Ministry of Natural Resources District Parks Supervisor George Scott and John Williams and Dave Clarke of the Otonabee Regional Conservation Authority also offered assistance and documentation.

Valuable floristic data were also provided by Donald M. Britton of the University of Guelph, and P. M. Catling of the Biosystematics Research Institute, Agriculture Canada.

Daniel F. Brunton,
July 1990, Ottawa

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CHAPTER 1. REGIONAL BACKGROUND

This chapter is designed to provide a regional context into which the ecological and geographical characteristics of the Warsaw Caves ANSI study area can be placed. This will assist in the development of a better appreciation of the significance of particular resources within the study area.

(1) Location

The Warsaw Caves ANSI is situated along the Indian River, centred 2.5 km north of the village of Warsaw and approximately 10 km east of the town of Lakefield (Figure 1). The boundary between the sedimentary limestone and the metasedimentary and granitic Canadian Shield is less than 15 kms to the north of the site. The Indian River flows underground for a short distance in the northern portion of the study area. The site is approximately 270 ha in size and is centred at Latitude 44° 27' North, Longitude 78° 07' West.

The study area includes most of the Otonabee Region Conservation Authority's Warsaw Caves Conservation Area. It is completely within Dummer Township in Peterborough County.

(2) Land Use

The Warsaw Caves Conservation Area provides camping, hiking and picnicking facilities, mostly arranged west of the Indian River near the conservation area's internal road and the maintenance facility by Caves Road (Figure 2). Water access is also provided at the north end of the area, providing boating opportunities along the river between the conservation area and the village of Warsaw.

A small area of old pasture in the centre of the site abuts the power line corridor which crosses the study area from northeast to southwest. Evidence of former livestock grazing activity in the study area is evident in this pasture as well as in the limestone plain area 1 km north of it. The only active agricultural activity evident at present is indicated by cattle trails through the Sugar Maple bush at the southern end of the Warsaw Caves ANSI area.

A number of residential establishments line the eastern side of the Indian River shore, even occupying areas where high shore cliffs have required that elaborate stairway systems be built to provide water access to these properties. Newly cut and flagged survey lines indicate that additional development is being undertaken at the present time along the western shore of the river south of the power line.

While the Warsaw Caves Conservation Area is owned by the Otonabee Region Conservation Authority, the area south of it towards the village of Warsaw is privately owned.

3) Study Objectives

The objectives of this study are as follows:

- i - to provide a detailed life science inventory of the Warsaw Caves ANSI.
- ii - to assess the significant life science resources of the Warsaw Caves ANSI and their contribution as representational or unique features satisfying the Ontario Ministry of Natural Resources life science protection objectives.

Figure 1: Location of the Warsaw Caves ANSI in southern Ontario

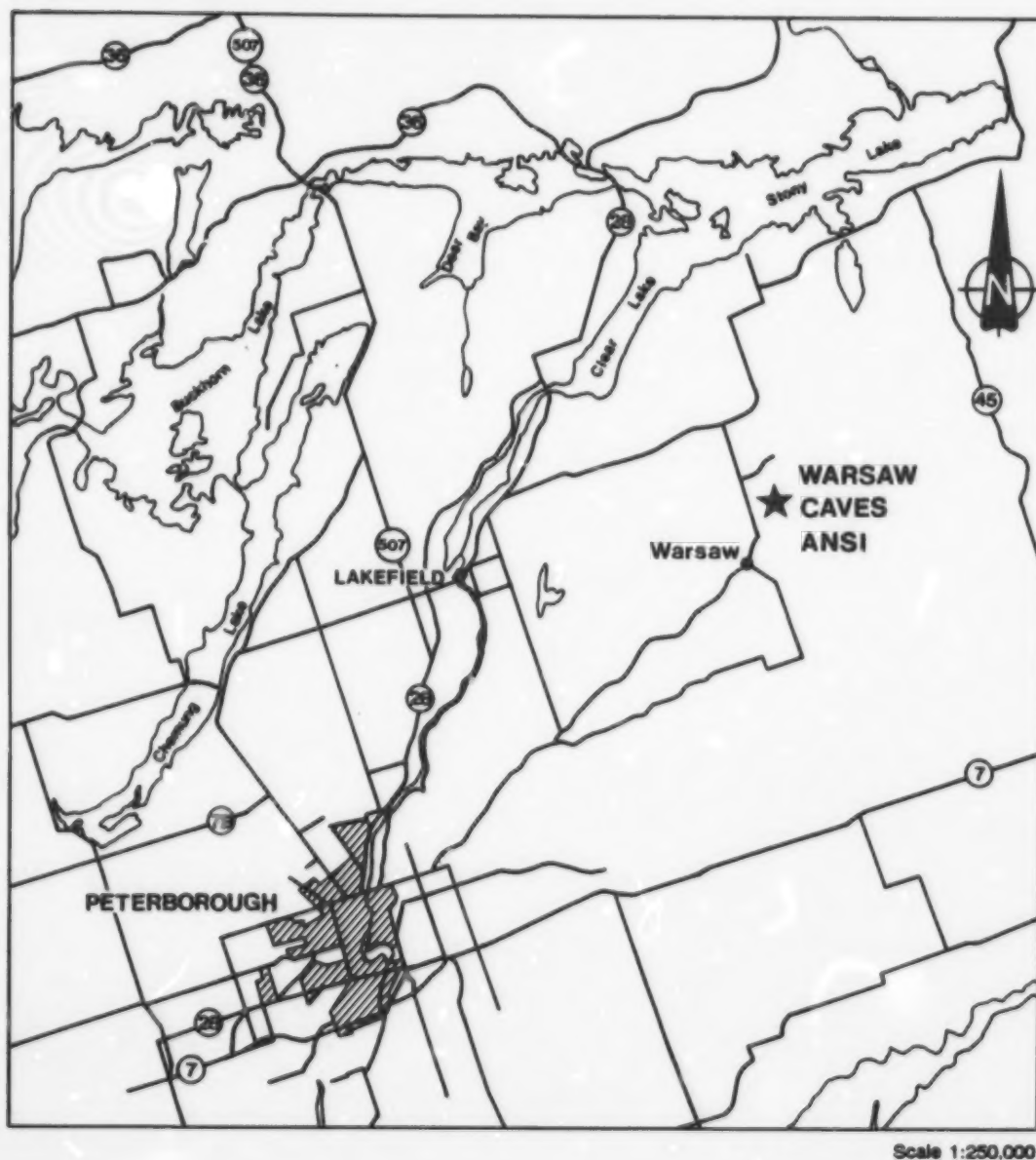
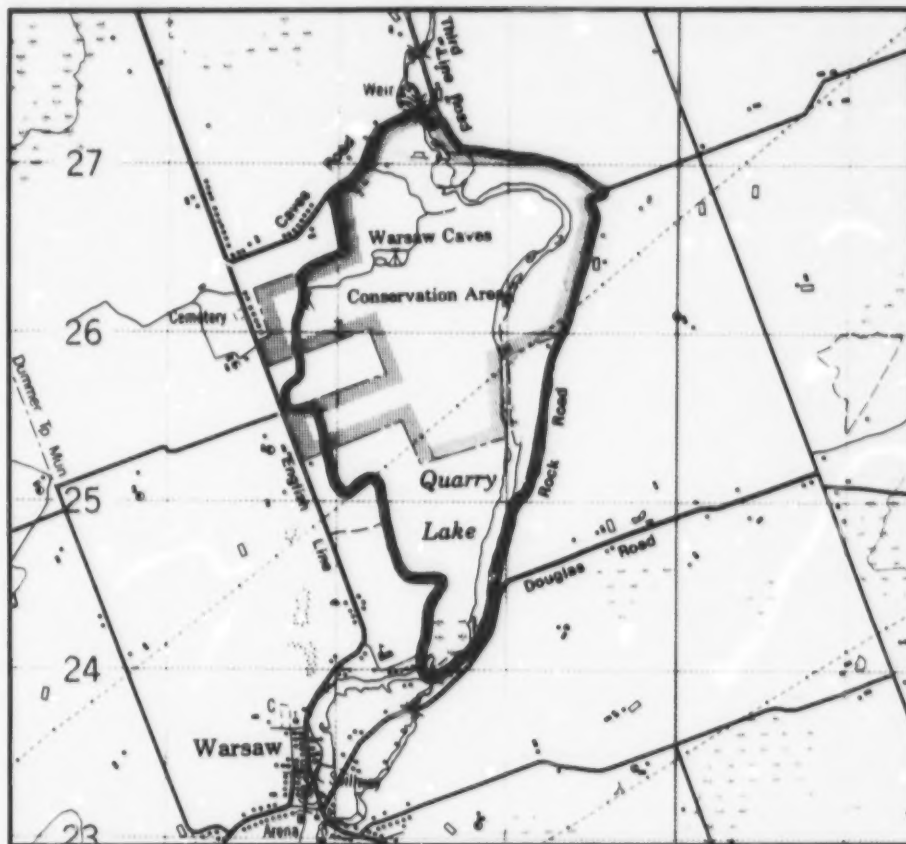


Figure 2: Warsaw Caves ANSI Situation



Scale 1:40,000

(4) Methodology

Discussions with Ontario Ministry of Natural Resources personnel in the Regional and District Offices knowledgeable of the study area were undertaken early in the study. A preliminary review of aerial photographs of the site, the Site District 6-9 ANSI evaluation (Lindsay 1986) and life sciences framework literature was conducted in order to obtain an overview of the site. Searches of basic regional and provincial floral and faunal literature helped to identify potential significant elements.

The field work was undertaken in late summer (September 4 to September 8). Black and white photographs were taken of major vegetation types and life science features and voucher specimens for significant or unknown plant species made. The vegetation was mapped in the field on 1:10,000 aerial scale photograph overlays, for conversion to a final composite in the office (see Map 1). Although too late in the season for breeding evidence to be established in most cases, observations of bird species were noted, as were incidental records of other mammal and herpetological fauna. Time constraints were too great to permit detailed evaluation of fauna in any case. All habitats in the Warsaw Caves ANSI study area were examined in this manner, with access being effected by canoeing along the Indian River, driving along the internal road system and conducting extensive on-foot transects across all parts of the study area.

Following field studies the plant voucher specimens and photographs were processed, sorted and identified as required. Resource specialists were contacted for more detailed information on significant life science elements and additional research at the National Museum of Canada was undertaken to assess particular species of importance. A detailed review of the appropriate research literature was conducted at this time.

The draft report was prepared in January 1990. Following review of that draft by Regional and District Ontario Ministry of Natural Resources personnel, the final draft was prepared that incorporated the comments and criticisms of the review process.

(5) Previous Studies

The site is far better known from an earth science perspective because of the interest in the karst features found within it. It is discussed in a provincial study of southern Ontario caves (Ongley 1965) and in a national inventory of karst areas (Ford and Quinlan 1973). These studies concluded that the karst features of the site were of modest earth significance, a view shared in the brief evaluation undertaken by G. Cordiner (in. lit., Environmental Data Card, Ontario Ministry of Natural Resources Central Region files, 1981). He concluded that the site was Regionally Significant for the representation it provided of a portion of the Dummer Moraine Outwash.

In her assessment of Site District 6-9, K. Lindsay (1986) described the Warsaw Caves Conservation Area as a Provincially Significant ANSI. It is one of only three such karst complexes in Site District 6-9¹. K. Lindsay (1986) identified the primarily representational value of the study area as relating to the complex of upland habitats typical of the site district existing in conjunction with the unusual karst landform.

Past life science data on the site are few and far between. Exploration of the caves in the mid 1960s discovered that bats used the larger, drier caverns as a hibernaculum (B. Fenton, pers. comm.) and investigation later that decade in winter time by P. M. Catling and J. G. Woods confirmed its use and recorded at least one rare species (P. Catling, pers. comm.).

S. Varga, Ontario Ministry of Natural Resources Central Region office, undertook a brief reconnaissance and aerial photographic examination of the study area in July 1987; his mapping on aerial photograph overlays was available for this examination.

Occasional vascular plant specimens from the Warsaw Caves ANSI are encountered in Ontario herbaria (particularly TRT), some dating back to the late 19th century. A survey of fern species in 1976 by D. M. Britton (pers. comm.) confirmed a number of these records, including the old report of the rare Smooth Woodsia (*Woodsia glabella*) which was noted with suspicion until then.

The site received a brief reconnaissance assessment as part of 1972 International Biological Program surveys, but no particularly significant life science features were noted (D. J. White, pers. comm.). The checksheet prepared by K. Lindsay for her Site District 6-9 assessment was based on White's report as well as her own field visits between 1981 and 1986 (Lindsay 1986).

¹ The other two are: 1) Moira Karst (31 C/6 150115) and, 2) Roblin Hell-holes (31 D/8 285260). The relative ranking of these three sites within a regional or provincial context is not known.

CHAPTER 2. RESOURCE INVENTORY

This chapter provides a detailed discussion of the vegetation and flora of the study area. Faunal data are dealt with in the general assessment appropriate to the quantity of these data. An overview of the earth science situation is also presented in order to put life science features and systems into a better ecological framework.

1) Geology and Geomorphology

The entire area is underlain by 500 million year old Ordovician limestone (Freeman 1979) upon which Wisconsin glaciation moraine deposits are situated. These deposits are part of the large Dummer Moraine complex that extends across the southern edge of the Canadian Shield from Sturgeon Lake eastward to western Frontenac County. Throughout the moraine complex the till is stony and often covers upland situations with only a thin layer. Bedrock outcrop areas occur on the Dummer Moraine and in the study area. Limestone cliffs form along the river, being especially pronounced (up to 30 m high) and frequently free of tree cover, in the northeast of the study area. Here, where the river makes a strong bend to the east, a deep canyon is formed by opposing limestone cliffs and steep slopes.

The study area was released from the cover of the Wisconsin glaciers about 12,500 years ago (Dyke and Prest 1986). The important Kirkfield Outlet of glacial Lake Algonquin, draining the western Great Lakes basin, ran west to east along the northern edge of the Dummer Moraine, cutting through it along spillways. These included one which ran from Stony Lake and along the Indian River and through the study area (Chapman and Putnam 1984). The enormous quantities of water rushing along the Indian River spillway created the underground caverns, the sink holes and many of the other karst features found in the northern portion of the Warsaw Caves ANSI. This spillway eventually emptied into Rice Lake and through it into Glacial Lake Iroquois (proto Lake Ontario) and thus to Glacial Lake Vermont (later occupied by a portion of the Champlain Sea) (Dyke and Prest 1986). This large and important spillway was active for about 1,000 year (12,000 to 11,000 years B. P.) and was one of two drainage channels in this outwash system for the upper Great Lakes Basin.

An esker deposit essentially divides the ground moraine dominating the northwestern portion of the Warsaw Caves ANSI from spillway system along the Indian River (Figure 3). It is not striking in the field, appearing more like a pair of lined-up drumlin features during this investigation.

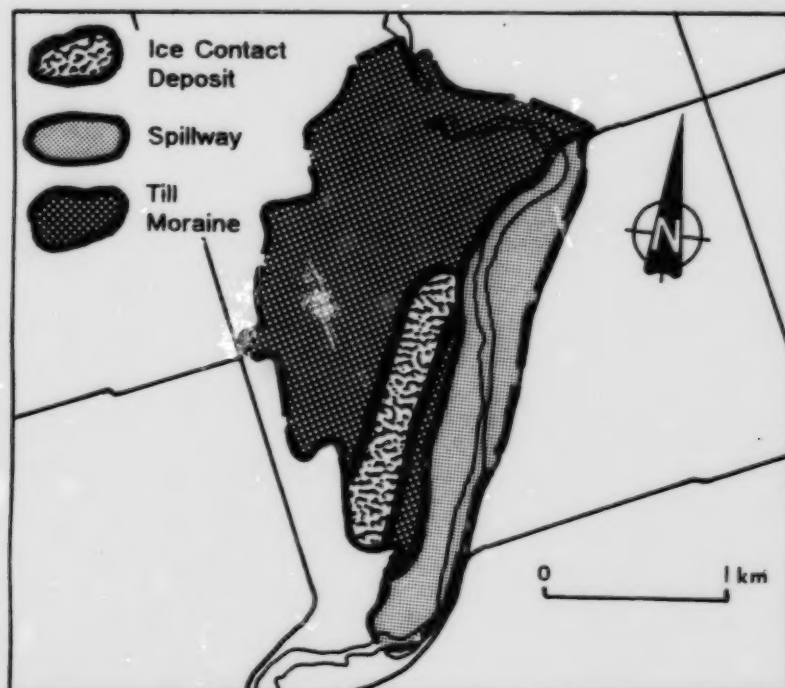
It has been established that the Champlain Sea, which extended to within 150 km of the study area during its maximum extent (Freeman 1979) had a distinctly arctic-subarctic environment (Harington 1989), suggesting that a cooler climate also affected the study area. The landscape of the Warsaw Caves ANSI about 11,500 years ago, then, was likely one of scrubby, Boreal or tundra-like vegetation with extensive unforested areas of lichen-heath, open gravel and sand slopes and bare limestone bedrock ledges and cliffs.

Amelioration of the climate and especially the climatic warming effected by the Hypsithermal period that extended from about 7,000 years B. P. to about 4,000 years B. P. (McAndrews *et al.* 1987) encouraged the establishment of much of the existing vegetation and flora. By about 2,500 years B. P. the current landscape vegetation was established.

2) Vegetation

The Warsaw Caves ANSI study area is situated within the Huron-Ontario Forest District as described in Rowe (1972). This is a large area within the Great Lakes-St. Lawrence Forest Region in southern Ontario, extending from Manitoulin Island eastward to the Penetang Peninsula and across the northern edge of the Ordovician lowlands to Kingston.

Figure 3: Geomorphology of the Warsaw Caves ANSI
(adapted from Chapman and Putnam 1986)



Hills' (1959) analysis of Ontario landscape and vegetation is based on different units from those in Rowe (1972). He divides Ontario into *Site Regions* (areas of land within which the response of the vegetation to the landform follows a consistent pattern) and *Site Districts* (areas within Site Regions with a characteristic pattern of physiographic features). He places the study area within the Madoc Site District (6-9) of the Simcoe - Rideau Site Region (6). Site Region 6 is described as a landscape of gently undulating to rolling terrain of ice-lain materials deeply covering the bedrock, with local plains of lacustrine deposits and shallowly covered limestone plains (Hills 1959). American Beech, Sugar Maple and Eastern Hemlock characterize the ultimate forest type on fresh, normal sites, with oak and hickory on warmer sites. Eastern Hemlock, White Cedar and Yellow Birch, with some spruce, typify wet sites. Although not stated by Hills (1959), another important characteristic is that the much of the Site Region (including Site District 6-9) is situated on sedimentary bedrock, in contrast to the almost exclusively Precambrian bedrock-based Site District 5 to the north and the exclusively sedimentary bedrock-based Site Region 7 to the southwest.

Hills (1959) describes the Madoc Site District as *an area of high lime, stony loamy till with outcrops of shallowly covered limestone and trains of siliceous and low-base sand*. It extends in a narrow band along the Dummer Moraine from Lake Simcoe eastward to Kingston. A life science analysis of Site District 6-9 was produced by K. Lindsay (1986), in which landform - vegetation complexes are identified and representative natural areas of each are noted, where possible.

Much of the site district, including the area around the Warsaw Caves ANSI, has been severely disturbed by agricultural, industrial and residential development. Lindsay (1986) estimates that only about 30% of total site district area remains in a natural state.

The vegetation is divided into three large categories: Upland, Lowland and Open Wetlands. These are subdivided into groupings labelled by their dominant species.

Nonforested and aquatic vegetation is categorized by the elements identified in the analysis of a large body of vegetation association data in southcentral Ontario (Brunton 1982), with reference to Riley (1988) for more precise descriptions of wetland units.

This system includes consideration of the regional site type matrix system often employed in Ontario Ministry of Natural Resources life science studies (Beechey and Davidson 1980) which employs the identification of dominant vegetation species as a means of labelling vegetation variation within a biophysical framework (the matrix). Representative vegetation formulae are included within the description of each vegetation type. The associations are also arranged within a Site Type Matrix for the Warsaw Caves ANSI (Figure 4).

Figure 4: Vegetation Site Type Matrix for the Warsaw Caves ANSI

		ARID	VERY DRY	DRY	DRY MESIC	MESIC	WET MESIC	WET	VERY WET	SATU-RATED	OPEN WATER
COOLER	Rock				3b		3a				
	Sand									11a, 11b 3a	
	Loam									10a	
	Clay										
	Organic									14a, 14b 14c	
NORMAL	Rock		7b, 7c 7d	7a							15a
	Sand			4a, 5a 5b	8a, 9b					12a	
	Loam				6b, 6c	6a	6d	10b			
	Clay										
	Organic										
WARMER	Rock	2b	2a, 2c	4b							
	Sand										
	Loam										
	Clay										
	Organic										

The classification of the vegetation of the Warsaw Caves ANSI study area includes the following categories:

UPLAND VEGETATION

- 1 - Developed Land
- 2 - Open Alvar-like Bedrock Plain
- 3 - Limestone Cliffs and Ledges
- 4 - Upland Thicket
- 5 - Upland Meadow
- 6 - Mature Deciduous Forest
- 7 - Successional Coniferous Forest
- 8 - Successional Deciduous Forest
- 9 - Successional Mixed Forest

LOWLAND VEGETATION

- 10 - Successional Deciduous Swamp
- 11 - Successional Mixed Swamp

OPEN WETLANDS

- 12 - Cat-tail/Bulrush Marsh
- 13 - Thicket Swamp
- 14 - Sedge Meadow
- 15 - Open Water Aquatics

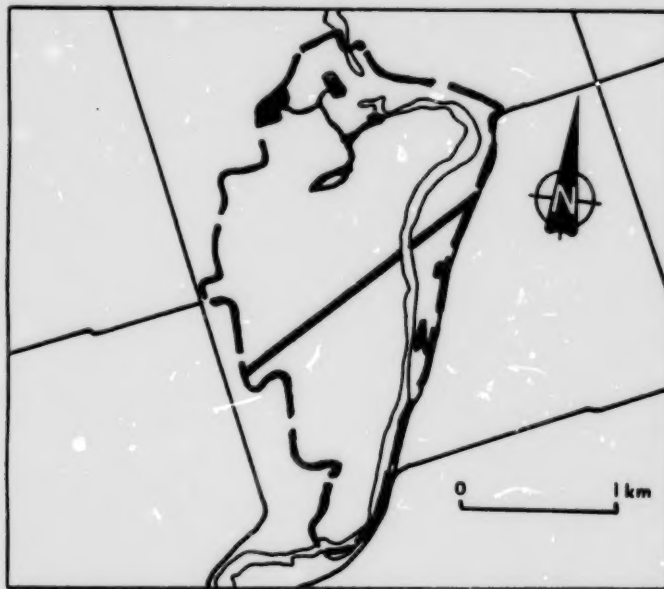
The following vegetation descriptions treat each of the vegetation variations observed in the study area. The maps accompanying each vegetation type are not cartographically accurate and are intended only to provide a graphic image of that vegetation's representation. Readers are referred to Map 1 (inside back cover) for an accurate and detailed delineation of the vegetation of the study area.

Photographs of many of examples of many of these vegetation types follow the written descriptions (pages 27 - 33).

VEGETATION TYPE 1: DEVELOPED LAND
(Figures 5 and 20)

Site: Various upland sites in association with facilities, such as parking lots, lawns, roadways, etc. are found in the northern portion of the study area; this occupies a small proportion of the site.

Figure 5: Vegetation Type 1 - Developed or Severely Disturbed Land



Vegetation Characteristics: It is dominated by a wide variety of non-native plant species, reflecting the destruction of the native vegetation in these sites and the development of an artificial landscape.

Typical species include:

Chrysanthemum leucanthemum
Agropyron repens
Trifolium spp.
Eragrostis minor

Hypericum perforatum
Taraxacum officinale
Plantago major
Poa annua

Further Considerations: This vegetation is of no biological significance. No rare native species have been found only here although three regionally significant species, *Panicum philadelphicum*, *Cerastium arvense* and *Minuartia michauxii*, are present along some roadsides where bedrock is exposed.

VEGETATION TYPE 2 - OPEN ALVAR-LIKE BEDROCK PLAIN
(Figures 2 and 21)

Site: It is found as exposed limestone bedrock, in arid, level plains (Figures 21 and 22) in hotter than normal situations, often with little or no vegetation and with frequent fissures across the surface of the ground. One large and several small limestone plains are situated in the northcentral portion of the study area.

Figure 6: Vegetation Type 2 - Open Alvar-like Bedrock Plain



Vegetation Characteristics: The open bedrock plain is alvar-like (Catling *et al.* 1975, Lindsay 1986), but lacks the spring-flooded, summer-droughted characteristic of that uncommon habitat (cf. Stephenson 1983, Stephenson & Herendeen 1986, Baskin and Baskin 1985, pers. obs.). At the Warsaw Caves ANSI it is fissured and, thus, drier throughout than the latter, much like the fissured limestone plains of western Manitoulin Island (cf. Morton & Venn). Drought-tolerant grasses and herbs are common here, with similarly selective non-native species.

The vegetation associations recorded for this type are as follows:

- 2a) *Toxicodendron rydbergii*³ - Staghorn Sumac³ - Red Juniper²
(southwest side of Quarry Lake)
- 2b) *Danthonia spicatum*³ - *Senecio paupercula*³ - *Hieracium piloselloides*² - *Chrysanthemum leucanthemum*¹ - *Sedum acre*¹
(southwest side of Quarry Lake)
- 2c) *Agropyron repens*³ - *Cladina* (lichen)³ - *Hieracium piloselloides*¹ - *Penstemon hirsutus*¹
(northeast of Quarry Lake)

Typical ground flora includes:

Echium vulgure
Cerastium arvense
Panicum philadelphicum
Satureja vulgaris
Scutellaria parvula
Satureja acinos

Saxifraga virginensis
Hypericum perforatum
Minuartia michauxii
Mondarda fistulosa
Isanthus brachiatus
Sedum acre

Further Considerations: Although the limestone flats support a number of species also found in the uncommon and important alvar habitat elsewhere in Site District 6-9, these areas are disturbed (by former cattle grazing) and heavily infested with non-native taxa, thus greatly reducing their level of natural significance. A number of regionally significant plant species typical of alvars and limestone plains elsewhere in southern Ontario (cf. Catling *et al.* 1975) are found in this vegetation: *Lycopodium tristachyum*, *Cerastium arvense*, *Minuartia michauxii*, *Panicum philadelphicum*, *Arabis pycnocarpon*, *Rosa acicularis*, *Zanthoxylum americanum*, *Isanthus brachyactis*, *Hedeoma hispida*, *Scutellaria parvula* and *Hedeoma hispida*.

VEGETATION TYPE 3 - LIMESTONE CLIFFS AND LEDGES

(Figures 7, 23, 24, 25)

Site: These vary from low, cool, shaded, dry-mesic woodland ridges along the Indian River to 30 m high dry, southwest-facing, hotter than normal cliff faces and cool, wet to mesic, forested cliff-faces.

Vegetation Characteristics: The cliffs vary as widely as their highly variable aspect, moisture regime and shading conditions prescribe; this supports a wide variety of species of exposed, calcicolous substrates, dominated by mosses and frequently beneath the shade of varying amounts of cover by White Cedar. Vascular flora are frequently very sparsely distributed across open rock faces.

Figure 7: Vegetation Type 3 - Limestone Cliffs and Ledges



The vegetation associations recorded for this type are as follows:

- 3a) White Cedar⁸ - *Anomodon* (moss)³ - *Asplenium rhizophyllum*¹
(east side of Indian River at the bend)
- 3b) White Cedar⁸ - *Anomodon* (moss)⁴ - *Carex eburnea*¹
(northeast shore of Quarry Lake)

Typical ground flora of the bedrock cliffs and ridges include:

Asplenium rhizophyllum
Carex eburnea
Toxicodendron rydbergii
Polypodium virginianum

Asplenium trichomanes
Cystopteris fragilis
Dryopteris marginalis
Maianthemum canadense

Further Considerations: The cliff complexes, especially those open and shaded cliffs along the east shore of the big bend of the Indian River and at the northeast end of Quarry Lake are in a natural condition and support floristic associations not found elsewhere in Site District 6-9. These are not represented elsewhere in the site district and are provincially significant. The provincially significant *Woodsia glabella* fern and regionally significant *Cryptogramma stelleri* and *Asplenium rhizophyllum* occur in this vegetation types.

VEGETATION TYPE 4 - UPLAND THICKET (Figure 8)

Site: It is found on a variety of dry to dry-mesic sites in shallow to deep soils across the study area, though more commonly close to development or former development sites.

Figure 8: Vegetation Type 4 - Upland Thickets



Vegetation Characteristics: A variety of drought and heat tolerant shrubs and herbs dominate this early successional sites recovering from severe disturbance. Succession usually goes from open meadows and bedrock flats on to upland intolerant forest.

The vegetation associations recorded for this type are as follows:

- 4a) Smooth Sumac⁴ - *Spiraea alba*³ - White Pine (saplings)² - Common Juniper¹
(south of Third Line Road north of Douglas Road)
- 4b) Smooth Sumac⁵ - Red-osier Dogwood⁴ - *Spiraea alba*¹
(south end of Quarry Lake)

Typical ground flora includes:

Pteridium aquilinum
Juniperus virginianum
Asclepias syriaca
Celastrus scandens

Achillea millefolium
Potentilla recta
Phleum pratense
Rubus strigosus

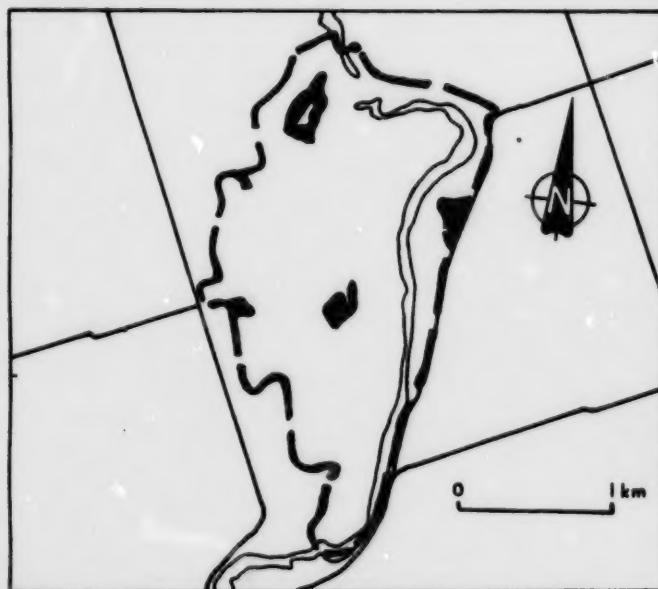
Further Considerations: This vegetation is transitory in nature, resulting largely from human-induced disturbances, and is of no particular life science significance.

VEGETATION TYPE 5 - UPLAND MEADOWS

(Figures 9 and 26)

Site: It is found in dry to dry-mesic sandy sites with some soil development over limestone bedrock. It is uncommon in the study area, being confined to areas of human disturbance in the northern half of the site (although much of the landscape surrounding the study area is this vegetation).

Figure 9: Vegetation Type 5 - Upland Meadow



Vegetation Characteristics: This vegetation is a reflection of the origin of the habitat, viz, a product of human disturbance of the landscape. Non-native species dominate. Agricultural species such as various pasture grasses, are common. The vegetation is uncommon in the study area and succeeds into thicket and forest vegetation types.

The vegetation associations recorded for this type are as follows:

5a) *Bromus inermis*² - *Phleum pratense*⁴
(north of powerline, east of Indian River)

5b) *Agrostis gigantea*² - *Danthonia spicatum*² - *Phleum pratense*² - *Aster ciliolatus*²
(north of powerline on west side of Rock Road)

Typical ground flora includes:

Rubus strigosus
Potentilla norvegica
Asclepias syriaca
Juniperus communis
Malus pumila

Echium vulgare
Virgulus novae-angliae
Juniperus virginiana
Tragopogon pratensis
Vicia cracca

Further Considerations: This vegetation is transitory in nature, results from human-induced disturbances, is not known to support rare native species and is of no particular life science significance.

VEGETATION TYPE 6 - MATURE DECIDUOUS FOREST (Figures 10 and 27)

Site: The vegetation occurs on the deepest, best-drained soils resulting from glacial ice-contact deposition, in dry-mesic to mesic, normal situations. It is uncommon, being concentrated in the central area of the study area on either side of the power line.

Vegetation Characteristics: This vegetation is dominated by mature (140 year old) and submature (70 year old) Sugar Maple in association with American Beech, Ironwood, Basswood and White Ash and with clumps of Eastern Hemlock being locally important. The southern block has been managed for maple syrup harvesting and has skid trails thorough it and a manipulated cover of well spaced maples. The northern block is more natural in constitution, with no evidence of sugaring activity.

The vegetation associations recorded for this type are as follows:

6a) Sugar Maple¹⁰
(south of power line)

6b) Sugar Maple⁸ - Ironwood²
(west of Quarry Lake)

6c) Sugar Maple⁷ - Ironwood² - White Ash¹
(Third Line Road at Rock Road)

6d) Sugar Maple⁷ - Eastern Hemlock² - Basswood¹
(west side of block north of power line)

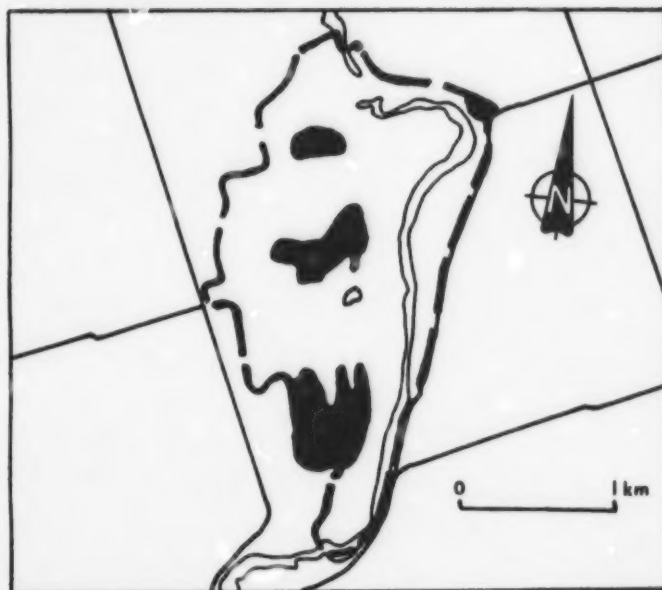
Typical ground vegetation includes:

Dryopteris intermedia
Viola pubescens
Uvularia grandiflora
Acer saccharum (seedlings)
Trillium grandiflorum
Carex arctata

Lonicera canadensis
Thalictrum dioicum
Allium tricoccum
Carex communis
Caulophyllum thalictroides
Ozmorhiza claytonii

Further Considerations: This vegetation is restricted and poorly represented in the site district, being accounted elsewhere only in the Collins Lake Upland Forest (Lindsay 1986). Its rarity in a protected state offers additional significance to the older southern block in the Warsaw Caves ANSI.

Figure 10: Vegetation Type 6 - Mature Deciduous Forest



VEGETATION TYPE 7 - SUCCESSIONAL CONIFEROUS FOREST

(Figures 11, 28, 29, 30)

Site: It is widespread in the study area in areas of thin to absent soil over fissured limestone bedrock in normal to warmer, dry sites. It constitutes the most common vegetation in the Warsaw Caves ANSI.

Vegetation Characteristics: This vegetation is dominated by White Cedar, with Balsam Fir, White Spruce and White Pine being important secondary species. Undergrowth is sparse. It will succeed to tolerant coniferous forest of pure White Cedar in drier sites and White Cedar and Eastern Hemlock in more mesic situations.

The vegetation associations recorded for this type are as follows:

- 7a) White Cedar⁷ - White Spruce³
(south end of Quarry Lake)
- 7b) White Cedar⁸ - Balsam Fir²
(west of Quarry Lake)
- 7c) White Cedar⁸ - White Pine⁴
(west of Quarry Lake)
- 7d) White Cedar⁵ - Balsam Fir³ - White Spruce²
(west of Indian River by the big bend)

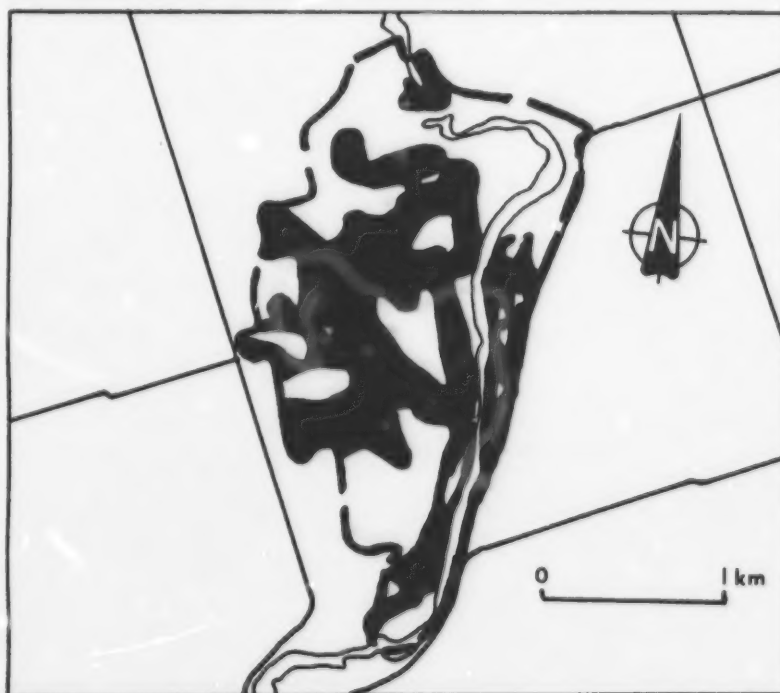
Typical ground vegetation includes:

Aster macrophyllus
Waldsteinia fragarioides
Toxicodendron rydbergii
Maianthemum canadense

Epipactis helleborine
Aquilegia canadensis
Danthonia spicatum
Aralia nudicaulis

Further Considerations: This vegetation is common in the limestone plains in the east of the site district and supports no unusual species. It is considered to be representative of coniferous forest on limestone plain in the site district (Lindsay 1984).

Figure 11: Vegetation Type 7 - Successional Coniferous Forest



VEGETATION TYPE 8 - SUCCESSIONAL DECIDUOUS FOREST

(Figure 12)

Site: This association is rare in the study area and is found in dry, shallow, sandy soil over bedrock outcropping overlooking the Indian River at the big bend, in normal microclimatic conditions.

Vegetation Characteristics: Two small stands of Large-toothed Poplar and Red Maple, with White Spruce and Sugar Maple as secondary elements, constitutes the dominants of this habitat. The undergrowth is dense, with tree seedlings (especially Choke Cherry) dominating. The ground vegetation is fairly diverse and reflects the disturbed nature of the vegetation. This habitat succeeds to tolerant deciduous forest.

The vegetation association recorded for this type is as follows:

- 8a) Large-toothed Poplar^a - Red Maple¹
(Lookout on east side of the big Bend, Indian River)

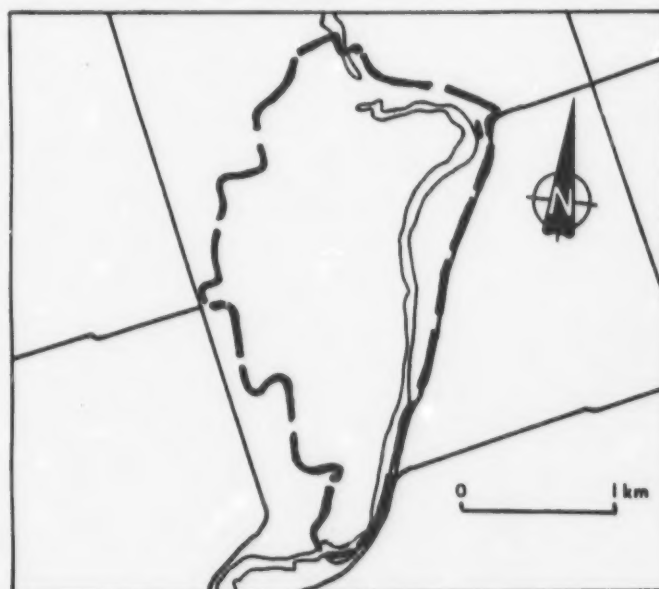
Typical ground vegetation includes:

Pteridium aquilinum
Celastrus scandens
Achillea millefolium
Trifolium repens

Aster cordifolius
Solidago hispida
Aster ciliolatus
Aster macrophyllus

Further Considerations: Although uncommon here largely because of shallow soil conditions, examples of this vegetation type are common in the site district. No unusual or otherwise especially significant plant or animal species were noted here and it is not considered to be a significant vegetation.

Figure 12: Vegetation Type 8 - Successional Deciduous Forest



VEGETATION TYPE 9 - SUCCESSIONAL MIXED FOREST

(Figure 13)

Site: The intermediate vegetation of the habitat is reflected in the variable site conditions here, viz, dry to dry-mesic, normal to cooler, thinly till-covered situations. It is found especially on sloping land and is most conspicuous along the northern borders of the Indian River.

Vegetation Characteristics: White Spruce, Red Maple, White Cedar, White Pine, White Birch and Trembling Aspen dominate, with conifers being the most important species in these sites. A tangled undergrowth of shrubs and herbaceous species evident. It will succeed to a variety of tolerant upland forest types.

The vegetation association recorded for this type is as follows:

- 9a) White Spruce³ - Red Maple³ - Balsam Fir² - White Pine²
(west side of Indian River north of power line)

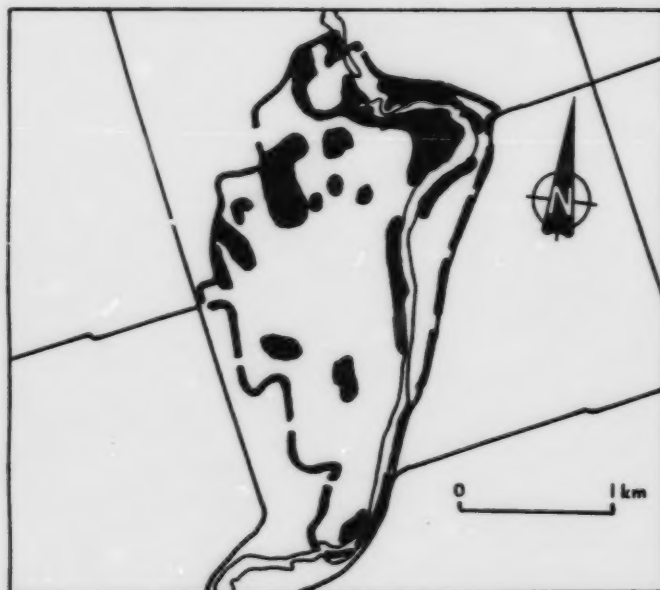
Typical ground vegetation includes:

Pteridium aquilinum
Aralia nudicaulis
Dryopteris carthusiana

Polygala paucifolia
Maianthemum canadense
Carex gracillima

Further Considerations: This vegetation is representative of mixed forests found on limestone plains in Site District 6-9 (S. Varga, pers. comm.). No rare or unusual species were found here.

Figure 13: Vegetation Type 9 - Successional Mixed Forest



VEGETATION TYPE 10 - SUCCESSIONAL DECIDUOUS SWAMP

(Figures 14 and 31)

Site: These areas are spring-flooded and wet to saturated through the rest of the growing season, with silty alluvial-loamy soil in normal to cool situations. It is rarely encountered in the study area.

Vegetation Characteristics: Black Ash and Basswood are the most common tree species, with Bur Oak, Black Cherry and White Elm being secondary. Undergrowth is dense and dominated by a tangle of shrubbery such as Speckled Alder, Red-osier Dogwood, Choke Cherry and Poison-ivy, with a diversity of wet-site herbaceous flora below it. Succession is towards mixed and, eventually, to coniferous forested swamp.

The vegetation associations recorded for this type are as follows:

- 10a) Black Ash⁶ - Basswood² - Bur Oak²
(southwest side of Quarry Lake)
- 10b) Black Ash⁶ - Choke Cherry³ - Basswood¹
(Indian River opposite boat launch)

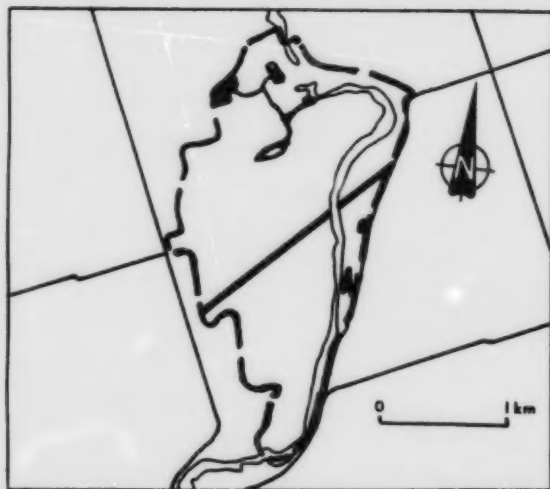
Typical ground vegetation includes:

Toxicodendron rydbergii
Cornus ammonum
Clematis virginiana
Matteuccia struthiopteris
Aster lateriflorus

Parthenocissus vitacea
Eupatorium maculatum
Viburnum opulus
Circaea luteiana
Rubus odoratus

Further Considerations: The habitat is uncommon in the study area and supports several locally uncommon and regionally significant species; *Ribes lacustre*, *Zanthoxylum americanum* and *Parthenocissus quinquefolia*. Black Ash swamp is common in Site District 6-9 (Lindsay 1984) and the small example in the study area is not considered to contribute substantially to site district representation.

Figure 14: Vegetation Type 10 - Successional Deciduous Swamp



VEGETATION TYPE 11 - SUCCESSIONAL MIXED SWAMP

(Figure 15)

Site: These areas, like those in Vegetation Type 10 (above), are spring-flooded and saturated through the rest of the growing season. A shallow organic layer overtopping sandy ground and bedrock outcroppings in these sites. The vegetation is uncommon in the study area.

Vegetation Characteristics: White Cedar and Black Ash dominate, with Balsam Fir being secondary. The saturated organic substrate is acidic in nature, supported a dense shrub vegetation of spiraea, Red-osier Dogwood and Speckled Alder. A diverse herbaceous vegetation covers the ground layer. This vegetation will succeed to tolerant coniferous forest.

The vegetation associations recorded for this type are as follows:

- 11a) White Cedar⁵ - Black Ash⁵
(southwest side of Quarry Lake)
- 11b) White Cedar⁵ - Black Ash³ - Balsam Fir²
(along campground road by turnoff to boat launch)

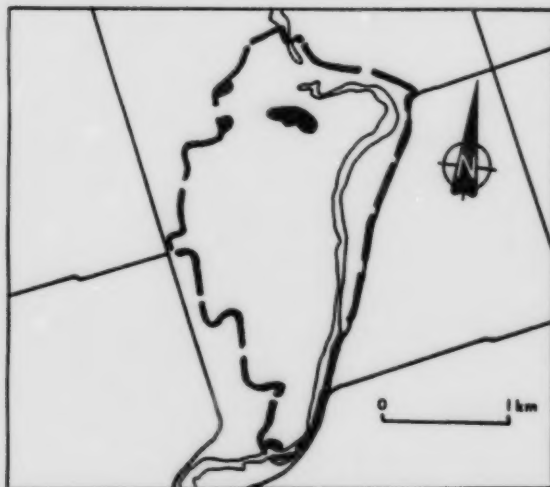
Typical ground vegetation includes:

Aster puniceus
Osmunda cinnamomea
Tiarella cordifolia
Asclepias incarnata

Eupatorium maculatum
Solidago rugosa
Dryopteris cristata
Rhamnus alnifolia

Further Considerations: The acidic substrate has encouraged the development of a variety of plant species not otherwise found in the predominantly calcareous area, but none are particularly rare. The vegetation is representative of mixed swamps scattered uncommonly across the site district (S. Varga, pers. comm.) but the examples found in the study area are too small to contribute a significant degree of life science representation within the site district.

Figure 15: Vegetation Type 11 - Successional Mixed Swamp



VEGETATION TYPE 12 - CAT-TAIL/BULRUSH MARSH

(Figure 16)

Site: A low depression in sandy soil in open, rolling landscape near the Conservation Area entrance road with normal microclimate characterizes the site. The area closest to the roadway has been partially infilled.

Vegetation Characteristics: This scrubby marsh vegetation is dominated by cat-tail (*Typha latifolia*) and Bulrush (*Scirpus cyperinus*), with invading shrub species and a sparse accessory flora. It has been disturbed by infilling, drainage manipulation and earth moving. It is succeeding towards swamp thicket and lowland forest.

The vegetation association recorded for this type is as follows:

- 12a) *Typha latifolia*⁹ - *Scirpus cyperinus*¹
(south of entrance road off Caves Road)

Typical ground vegetation includes:

Salix petiolaris
Bidens frondosa
Eupatorium maculatum
Lycopus uniflorus

Carex vulpinoidea
Carex bebbii
Mentha arvensis
Scirpus atrovirens

Further Considerations: This is a poor representative of a common vegetation type in Site District 6-9 and is of minimal life science significance.

Figure 16: Vegetation Type 12 - Cat-tail/Bulrush Marsh



VEGETATION TYPE 13 - THICKET SWAMP

(Figures 17 and 32)

Site: This vegetation type is found scattered along the Indian River in small areas affected by artificial water level maintenance resulting from the Warsaw weir. Numerous tiny sites also are found at the open edges of most wet areas throughout the study area. It occurs in saturated, cooler situations on thin sand or organic deposit over limestone bedrock.

Vegetation Characteristics: A tangled complex of deciduous shrub species (dogwood, willow, Speckled Alder) dominates, with a ground flora of marsh (above) and wet meadows (below) flora. It succeeds to deciduous and mixed lowland forested swamp.

The vegetation association recorded for this type is as follows:

13a) Speckled Alder^a - Silky Dogwood² - *Vitis riparia*¹ - *Myrica gale*¹
(south end of Quarry Lake)

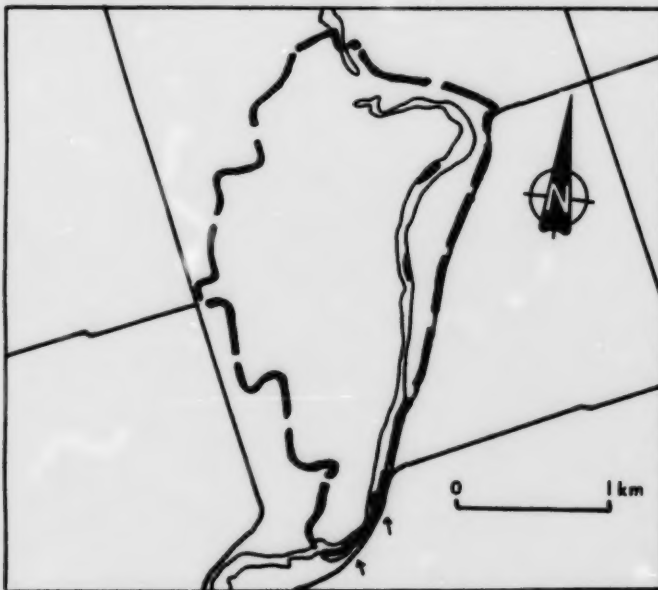
Typical species in this vegetation include:

Salix petiolaris
Eupatorium maculatum
Cornus amomum
Scirpus cyperinus

Salix bebbiana
Lycopus uniflorus
Cicuta bulbifera
Asclepias incarnata

Further Considerations: This vegetation type is common in the site district. The examples in the study area are small, disturbed by waterlevel manipulation and support no exceptional species of flora or fauna and are, accordingly, not considered to be particularly life science significant.

Figure 17: Vegetation Type 13 - Thicket Swamp



VEGETATION TYPE 14 - SEDGE MEADOWS

(Figures 18, 32 and 33)

Site: This vegetation type is found along the Indian River in narrow bands along the shore near the power line crossing. The vegetation has developed on a thin, often floating organic mat (though with little or no peat accumulation), in cooler, saturated sites.

Vegetation Characteristics: A variety of graminoid plants, especially sedges (*Carex*), dominate, with scattered seedling Larch and White Cedar trees and areas where low Sweet Gale shrubby is important. Although in areas affected by water levels stabilized by the Warsaw weir, this vegetation adapted to the changes and established essentially natural, fen-like meadows. They possess a strong resemblance to graminoid fen meadows, but without sufficient peat accumulation to satisfy that designation (cf. Riley 1988). The vegetation supports a diversity of organic-based flora found nowhere else in the study area. It succeeds to thicket swamp and, ultimately, forested swamp.

The vegetation associations recorded for this type are as follows:

- 14a) *Carex lasiocarpa*⁷ - *Phalaris arundinacea*³
(south end of Quarry Lake)
- 14b) *Carex lasiocarpa*⁸ - *Muhlenbergia glomerata*² - *Myrica gale*²
(east shore of Quarry Lake)
- 14c) *Carex lasiocarpa*⁷ - *Scirpus lacustris*² - *Myrica gale*¹ - *Thelypteris palustris*¹
(northeast shore of Quarry Lake)

Characteristic flora in this vegetation includes:

<i>Mentha arvensis</i>	<i>Carex lasiocarpa</i>
<i>Carex limosa</i>	<i>Lycopus uniflorus</i>
<i>Agalinus paupercula</i>	<i>Liparis loeselii</i>
<i>Muhlenbergia glomerata</i>	<i>Bidens cernua</i>
<i>Carex aquatilis</i>	<i>Typha latifolia</i>
<i>Thalictrum pubescens</i>	<i>Sagittaria latifolia</i>
<i>Salix candida</i>	<i>Selaginella eclipses</i>

Further Considerations: The vegetation type is well represented elsewhere in Site District 6-9 (Lindsay 1986). The examples in the Warsaw Caves ANSI are small and disturbed by water level manipulation and is accordingly of limited representational significance. It contains a number of species found nowhere else in the study area and so is afforded a high local level of significance. The regionally significant pteridophyte *Selaginella eclipses* is found in the vegetation.

Figure 18: Vegetation Type 14 - Sedge Meadows



VEGETATION TYPE 15 - OPEN WATER AQUATICS

(Figure 19)

Site: The Indian River supports aquatic associations in sites which are cooler to normal in microclimate and are over bare bedrock, thin sand bottom and thin organic deposits over bedrock.

Vegetation Characteristics: A wide variety of diverse aquatic associations composed of floating and submerged vascular plant species in stands varying from densely packed to highly dispersed. Eventual succession is towards thicket swamp and sedge meadows vegetation.

The vegetation association recorded for this type is as follows:

15a) *Nymphaea odorata*² - *Myriophyllum spicatum*⁴ - *Elodea canadensis*¹
(south end of Quarry Lake)

Characteristic flora in this vegetation includes:

Myriophyllum heterophyllum
Najas flexilis
Biden beckii

Potamogeton illinoensis
Potamogeton pectinatus
Vallisneria americana

Further Considerations: Several uncommon, regionally significant plant species are found in this habitat, offering a local level of life science significance to areas of the Indian River: *Potamogeton illinoensis*, *P. strictifolius* and *Callitriche verna*. Such aquatic associations are commonly represented in Site District 6-9 (Lindsay 1984).

Figure 19: Vegetation Type 15 – Open Water Aquatics

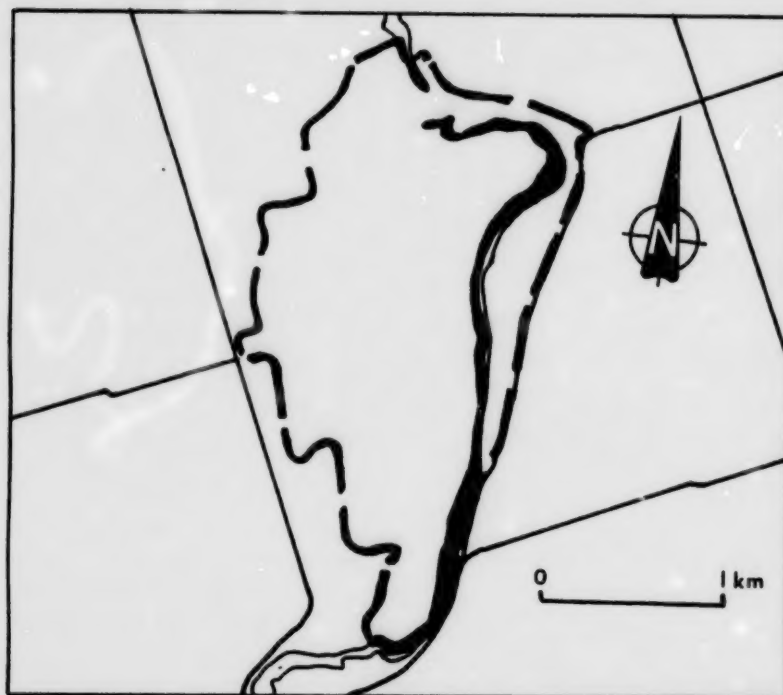


Figure 20: Severely disturbed ground at the swimming beach



Figure 21: Limestone plain with bare bedrock and sumac scrub (south end of Quarry Lake)



**Figure 22: Fissured limestone bedrock in open, disturbed limestone plain
(west of Quarry Lake)**



**Figure 23: Limestone outcrops in White Cedar/Red Maple/Balsam Fir Forest
(west-side of Quarry Lake)**



Figure 24: Shaded limestone cliff with dense fern (*Cystopteris bulbifera*) growth beneath overhang (east shore of Indian River at the big bend)



Figure 25: Shaded limestone cliff grotto (east side of the Indian River at the big bend)



Figure 26: Upland meadow with pasture grasses north of the powerline



Figure 27: Sugar Maple forest (west of Quarry Lake, south of powerline)



Figure 28: White Cedar/White Pine/Balsam Fir forest at The Caves (in ravine bottom)



Figure 29: White Cedar/White Pine/Balsam Fir forest on dry, level limestone flats west of Quarry Lake



Figure 30: White Cedar/White Pine/Balsam Fir forest (with White Spruce) at west shore of Quarry Lake



Figure 31: Black Ash swamp forest opposite Indian River boat launch



**Figure 32: Narrow band of shore meadow before alder-dominated thicket swamp
(south end of Quarry Lake)**



**Figure 33: Fen-like sedge meadows dominated by *Carex lasiocarpa*
(north of powerline crossing)**



3) Floristics

Approximately 370 species of vascular plants were recorded during the present investigation of the Warsaw Caves ANSI (Appendix A). The majority of these taxa are typical for the Peterborough - Durham section of Ontario Ministry of Natural Resources Central Region (Riley 1989). Despite the rich geomorphological history of the site involving the activity of postglacial spillways and related features (page 5), the site contains few unusual species reflecting that past.

Examples that illustrate the floristic affinities of the flora of the Warsaw Caves ANSI study area are indicated below.

Northern Affinity

Several species found in the study area have ranges typically extending over a wide area of the Boreal forest of northern Ontario and are near (or at) the southern limit of their range here:

Selaginella rupestris
Woodsia glabella
Carex limosa
Bidens beckii

Ribes lacustre
Geranium bicknellii
Viola adunca

These plants are found on the alvar-like limestone flats, the limestone cliff areas of bedrock outcrop, in lowland mixed swamp and in the open river. It is somewhat surprising that more northern floristic elements were not observed, given the excellent potential for such species on the Indian River cliffs and fen-like meadows.

Southern Affinity

There are twenty species (approximately 6% of the flora) normally found across the sedimentary lowlands of southern Ontario and/or the northeastern United States that are at or very near the northern limit of their ranges in the Warsaw Caves ANSI.

Selaginella eclipes
Asplenium rhizophyllum
Juniperus virginianum
Potamogeton illinoensis
Panicum philadelphicum
Sporobolus vaginiflorus
Carpinus caroliniana
Ulmus rubra
Minuartia michauxii
Crataegus punctata

Geum canadense
Zanthoxylum americanum
Rhus glabra
Parthenocissus quinquefolia
Cornus amomum
Cornus foemina
Isanthus brachiatus
Hedeoma hispida
Galium obtusum
Solidago flexicaulis

These are found in a wide variety of habitats, with the tolerant deciduous upland forest and limestone plains contributing the most species.

Special Habitats

A number of species typically found in open graminoid fens occur in the fen-like meadows along the Indian River. None of these is more than locally uncommon.

Muhlenbergia glomerata
Carex lasiocarpa
Salix candida

Rosa palustris
Carex limosa
Agalinus pauperculus

The disturbed alvar-like limestone plains along the western side of Quarry Lake support a number of species typically found in alvars (cf. Catling *et al.* 1975). Several are locally uncommon and others (marked *) are Regionally Significant.

Selaginella rupestris
Juniperus virginianum
Panicum philadelphicum *
Sporobolus vaginiflorus
Cerastium arvense

Viola adunca *
Minuartia michauxii *
Isanthus brachiatus *
Hedeoma hispida *
Monarda fistulosa

Introduced Species

Over 70 species (approximately 20%) of the recorded flora of the Warsaw Caves ANSI study area is non-native in origin. That fits within the range (20 - 25%) for the alien component of wild lands across southern Ontario. Although found in virtually all habitats in the study area (including aquatic vegetation associations), introductions are most along roadways and at other severely disturbed sites. Typical species include:

Trifolium spp.
Epipactis helleborine
Myriophyllum spicatum
Veronica officinale
Agropyron repens
Cardaria draba
Rumex crispus
Sedum acre

Melilotus alba
Phleum pratense
Lythrum salicaria
Taraxacum officinale
Potentilla recta
Hypericum perforatum
Arenaria serpyllifolia
Daucus carota

4) Fauna

There were insufficient resources available to permit the evaluation of faunal data at the same level as floral and vegetational features and associations. Faunal data were gathered incidentally in conjunction with the floristic/vegetational investigation and were also assembled from established literature sources.

Birds

While approximately 200 species of birds likely migrate through or nest in the study area (cf. Godfrey 1986; Cadman *et al.* 1987), much fewer than that number were observed during the present study (Appendix 2). The late season of this study - well after the breeding season and when migration was well advanced - further reduced the scope of observations.

None of the species observed would be considered more than locally significant. Rising (1986) indicates that the uncommon Grasshopper Sparrow was observed in this area during the Ontario Breeding Bird Atlas Program and habitat (viz, dry, sparsely vegetated open sites) exists in the Warsaw Caves ANSI. No certain records from the study area are known, however.

Mammals

Few mammal sightings were made during field investigations and none of these were of significant species (Appendix 3). The preliminary indications concerning the bat populations (see Significant Fauna) suggests a potential area of life science significance.

Amphibians and Reptiles

Appendix 4 lists the amphibian and reptile species noted during the study, as well as those with the study area within their range (Oldham *et al.* 1988; Plourde *et al.* 1988). All are considered typical of the general area.

CHAPTER 3. SIGNIFICANT FEATURES

The character of the natural environment of the study area and the life science features observed in it have been described in the Previous chapter, Resource Inventory (Page 5). The significance of these features and particular life science characteristics of the study area will be discussed and evaluated here in order to put the life science significance of the study area into a larger context.

1) Significant Vegetation

Part of the Limestone Cliffs and Ledges vegetation (Type 3) is provincially significant. The landform - vegetation complex involving the extensive cliffs along the Indian River, particularly those at the big bend of the river, are in natural condition, support a diversity of vegetational elements and represent a landform - vegetation complex known elsewhere in the site district only at the Roblin Hell-holes ANSI (Lindsay 1984).

The dry alvar-like limestone plains and woodlot outcrops, although bedrock based, are not so significant. They are well represented at other sites in the site district (Roblin Hell-holes, Moira Karst, Carden Alvar and the Camden East Alvar - Lindsay 1984). Several areas, particularly those involving the alvar-like bedrock plain, are also heavily impacted by human activity. However, given the extent of relatively undisturbed woodland outcrop area along the river it seems reasonable to consider this vegetation in the river corridor and by The Caves site to constitute regionally significant representative examples.

The mixed and coniferous forests (Vegetation Types 7 [Successional Coniferous Forest] and 9 [Successional Mixed Forest]) are also considered to be representative of similar vegetation on limestone bedrock elsewhere in the site district and thus, regionally significant (J. Riley & S. Varga, pers. comm.).

The other vegetation type in the Warsaw Caves ANSI study area that warrants designation as regionally significant is Vegetation Type 6 (Mature Deciduous Forest). Although disturbed by management for maple sugar collecting in the large southern block, this vegetation remains significant because of its very low level of representation in the site district. It is known elsewhere in Site District 6-9 only in the Collins Lake Upland Forest (Lindsay 1986).

2) Significant Flora

This section will provide a more detailed discussion of the particularly significant plant species that are known from the Warsaw Caves ANSI study area. A listing of all species observed is contained in Appendix A.

The levels of floristic significance are as follows:

PROVINCIAL - listed in Argus *et al.* (1982 - 1987) as rare in Ontario.

REGIONAL - listed in Riley (1989) as rare (or previously unknown) in the Peterborough - Durham portion of the Ontario Ministry of Natural Resources Central Region.

LOCAL - few records or previously unknown in the immediate vicinity of the Warsaw Caves ANSI study area.

PROVINCIALY SIGNIFICANT FLORA

None of the flora recorded for the Warsaw Caves ANSI study area are considered to be provincially significant by the usual criteria (above). Two species, *Woodsia glabella* and *Panicum philadelphicum* were formerly so considered but both now are felt to be known from a large enough number of sites in Ontario to warrant their removal from that list (Argus *et al.* 1982-1987).

While additional field investigations have clearly established *Panicum philadelphicum* to be widespread and locally abundant, such is not the case for *Woodsia glabella*. Accordingly, it will be treated as a provincially significant species in this study (see below).

1) *Woodsia glabella* (Smooth Woodsia) (Figures 34, 35 and 36)

This circumpolar fern is rarely encountered in North America south of the mid-arctic - low-arctic where it is locally common in mossy crevices in cool, protected calcareous rock faces and is rare in most Canadian provinces (Cody and Britton 1989).

It is confined in Ontario to the northern shore of Lake Superior and a very few post-glacial relict stations (Algonquin Provincial Park [Brunton 1989], Quetico Provincial Park [Walshe 1980]) (Figure 34). It is always found in small numbers at these sites (Butters and Abbe 1953; Given and Soper 1981; Walsh (1980) pers. obs.), many of which are based on records dating back many decades and into the 19th century.

The small-sized, relict populations found only in a narrowly-defined habitat in a geographically restricted area of Ontario is considered a persuasive argument for Provincially Rare status. Its deletion from the list (Argus *et al.* 1982-1987) suggests more a southern Ontario bias in evaluation (especially in comparison with other fern species remaining on that list) rather than a practical determination of status.

Britton and Anderson (1986) report the first record of this species from Manitoulin Island and comment that it is noteworthy "*as being a connecting link between those collected at ... Lake Superior and the famous disjunct colony near Warsaw ...*". The "famous stand at Warsaw" is the population first found here in the late 1800's and visited by several botanists since that time. D. M. Britton (pers. comm.) visited the population on June 10, 1976 and obtained material with which to conduct cytological research [D. B. Britton 4149]. This stand is 150 km from the next nearest colony (a very small population in eastern Algonquin Provincial Park - pers. obs.), 350 km from the Manitoulin Island record reported by Britton and Anderson (1986) and over 500 km from the closest Lake Superior colony (at Batchawana Falls - Taylor 1938).

The population at the Warsaw Caves ANSI is unusually substantial. Over 40 healthy clumps of this attractive little plant (Figure 35) grow vigorously on moss mats (*Anomodon* sp.) covering the lip of shaded, cool eroding ledges on a 7m high, west-facing limestone cliff at the northeast end of Quarry Lake (31 D/8 290252). Its presence here undoubtedly is related to the function of a major post-glacial spillway through the site at a time when a arctic - subarctic climate dominated (see page 5).

While private residential development has not had any apparent impact on the population, clearing of the cliff side White Cedar trees has occurred not far to the south. The site is already a typically dry for *Woodsia glabella*. The removal of the dense tree cover (Figure 36) would almost certainly lead to the elimination of the fern by desiccation.

Figure 34: Distribution of Smooth Woodsia (*Woodsia glabella*) in Ontario
(adapted from Cody and Britton 1989; Britton and Anderson 1986; Brunton 1989)



Figure 35: A mature plant of Smooth Woodsia (*Woodsia glabella*)



Figure 36: Smooth Woodsia (*Woodsia glabella*) site at Quarry Lake



REGIONALLY SIGNIFICANT SPECIES

- | | |
|-------------------------------------|--|
| 2) <i>Lycopodium tristachyum</i> | 12) <i>Ribes lacustre</i> |
| 3) <i>Selaginella eclipses</i> | 13) <i>Rosa acicularis</i> |
| 4) <i>Asplenium rhizophyllum</i> | 14) <i>Zanthoxylum americanum</i> |
| 5) <i>Cryptogramma stelleri</i> | 15) <i>Callitriche verna</i> |
| 6) <i>Potamogeton illinoensis</i> | 16) <i>Rhus glabra</i> |
| 7) <i>Potamogeton strictifolius</i> | 17) <i>Parthenocissis quinquefolia</i> |
| 8) <i>Panicum philadelphicum</i> | 18) <i>Viola adunca</i> |
| 9) <i>Minuartia michauxii</i> | 19) <i>Hedeoma hispida</i> |
| 10) <i>Cerastium arvense</i> | 20) <i>Isanthus brachiatus</i> |
| 11) <i>Arabis pycnocarpa</i> | 21) <i>Scutellaria parvula</i> |

Regionally significant flora are those *native* species listed as rare in Central Region (Riley 1989) or new for the Peterborough-Durham portion of Central Region.

2) *Lycopodium tristachyum* (Ground Cedar)

[New Peterborough - Durham area record]

This widespread, largely southern taxon, is locally distributed off the Canadian Shield in southern Ontario in dry, open, usually calcareous sand or limestone bedrock flats (Cody and Britton 1989; pers. obs.). It was found at the edge of extensive limestone flats west of the river at 31 D/8 287265. It is known elsewhere in Central Region only in Simcoe and Brant Counties (Riley 1989).

3) *Selaginella eclipses* (Meadow Spikemoss)

[New Peterborough - Durham area record]

A widespread fern ally of open, calcareous shores, muddy banks and limy seepage sites, it is common along the lower Great Lakes shores but uncommon and local inland (Soper 1963; Cody and Britton 1989). It is rare in most of Central Region (Riley 1989) and was found in the study area in wet crevices of open limestone bedrock at the southwest end of Quarry Lake at 31 D/8 288243.

4) *Asplenium rhizophyllum* (Walking Fern) (Figure 37)

[New Peterborough - Durham area record]

Although abundant in moist to dry, mossy, heavily-shaded calcareous rocks and bedrock outcrops along the Niagara Escarpment and in parts of the lower Ottawa Valley - Frontenac Axis area (Soper 1963; Lafontaine and Brunton 1974), it is rare in Central Region off the Niagara Escarpment. The abundant populations at the Warsaw Caves ANSI have been known for many years (Soper 1963). It grows here on shaded limestone outcrops and cliff ledges throughout, though in particular abundance along the Indian River.

Figure 37: Walking Fern (*Asplenium rhizophyllum*) on a limestone ridge



5) *Cryptogramma stelleri* (Slender Cliff-brake)

[New Peterborough - Durham area record]

The Ontario range and habitat of this species is very much like that of *A. rhizophyllum* (above), although this taxon has a much wider, more northern Canadian distribution (Soper 1964; Cody and Britton 1989). It too has been known for many years from the study area (Soper 1964), where it grows in wet (dripping), shaded limestone cliffs along the east shore of the Indian River (31 D/8 291253 [*vide* D. M. Britton (collection 4148, 10 June 1976)] and 31 D/8 294268).

6) *Potamogeton illinoensis* (Illinois Pondweed)

[New Peterborough - Durham area record]

A widespread species, though somewhat localized in the sedimentary lowlands of southern Ontario (Riley 1979), *P. illinoensis* is apparently rare in Central Region along the north shore of Lake Ontario (Riley 1989). It was observed commonly in the Indian River south of Quarry Lake.

7) *Potamogeton strictifolius* (Straight-leaved Pondweed)

[New Peterborough - Durham area record]

This species of clear, flowing slightly alkaline water is distributed across most of Ontario but is uncommon to rare in the south (Riley 1979; Dobson and Catling 1983). It is rare in Central Region beyond the Niagara Peninsula (Riley 1989). It is common in the Indian River at the south end of Quarry Lake in the Warsaw Caves ANSI.

8) *Panicum philadelphicum* (Philadelphia Panic Grass)

[New Peterborough - Durham area record]

Although previously thought to be provincially rare this species of dry, hot, limestone plains and alvar meadows (Catling *et al.* 1975; Dore and McNeill 1980) is now known to be too common in southern Ontario (off the Canadian Shield) to warrant that designation (Argus *et al.* 1982-1987). It is rare in Central Region, being otherwise known only from Simcoe County (Riley 1989). It was found to be abundant on all open limestone plain areas of Vegetation Type 2 in the Warsaw Caves ANSI study area.

9) *Minuartia michauxiana* (Rock Sandwort)

[=Arenaria stricta]

[New Peterborough - Durham area record]

Another of the southern calcicoles found commonly on alvar limestone plains (Catling *et al.* 1975), this species also is locally common on other open, dry, warm, calcareous rock sites, including marble deposits on the Canadian Shield. It is rare in Central Region and was apparently unknown east of the Halton area (Riley 1989). In the Warsaw Caves ANSI study area, however, it was found regularly on open limestone plain sites, especially in the large limestone plain near the power line (31 D/8 287265).

10) *Cerastium arvense* (Field Chickweed)

[New Peterborough - Durham area record]

This transcontinental perennial of dry, calcareous sites is very common in western Canada but is scattered locally and is often rare in Ontario in suitable habitat (Crompton *et al.* 1988). It can be 'weedy' in disturbed habitats in eastern Canada. It is common in dry, open limestone plains in the Warsaw Caves ANSI.

11) *Arabis pycnocarpa* var. *pycnocarpa* (Hairy Rock-cress)

[=Arabis hirsuta var. *pycnocarpa*]

[New Peterborough - Durham area record]

A member of a cosmopolitan complex, this taxon is a widespread, essentially southern plant of dry, rocky calcareous sites across Ontario (Ball 1985) and is rare east of the Niagara Peninsula in Central Region (Riley 1989). It was found on low, dry, east-facing cliffs along the Indian River at 31 D/8 299250.

12) *Ribes lacustre* (Bristly Black Currant)

[New Peterborough - Durham area record]

It is a transcontinental Boreal species that extends southward across the largely acidic Canadian Shield in Ontario in wet, boggy, shaded depressions; it is local and uncommon on the calcareous sedimentary lowlands of southern Ontario (Soper and Heimburger 1982) and is uncommon to rare across Central Region (Riley 1989). In the Warsaw Caves ANSI it was found in small numbers in a slightly acidic Black Ash - Basswood swamp forest opposite the boat launch (31 D/8 288268).

13) *Rosa acicularis* (Prickly Rose)

[New Peterborough - Durham area record]

While this shrub is very common in western Canada and on the Canadian Shield of Ontario in somewhat acidic, dry, rocky and sandy sites, it becomes uncommon to rare and local on similar sites on the sedimentary lowlands of southern Ontario (Soper and Heimbürger 1982). It appears to be rare in such sites north of Lake Ontario in Central Region (Soper and Heimbürger 1982; Riley 1989). A single bush was observed in the Warsaw Caves ANSI at the edge of the large limestone plain north of the power line at 31 D/8 287265.

14) *Zanthoxylum americanum* (Prickly Ash)

[New Peterborough - Durham area record]

This southern shrub clothed in dense, painfully sharp thorns, is typical of limestone plains in southern Ontario and is close to the northern limit of its range in the province at the Warsaw Caves ANSI (Soper and Heimbürger 1982). It is well distributed across Central Region (Riley 1989); mercifully, it was found only at the edge of the Black Ash - Basswood forest opposite the boat launch (31 D/8 288268).

15) *Callitriche verna* (Water Starwort)

[Rare in Central Region]

This is a common aquatic of fresh, quiet, often boggy water across the Canadian Shield of Ontario that becomes local and uncommon in more calcareous waters. It is known from few areas of Central Region (S. Varga, pers. comm.). A substantial population was observed in shallow, boggy bay of the Indian River below Quarry Lake at 31 D/8 286241.

16) *Rhus glabra* (Smooth Sumac)

[New Peterborough - Durham area record]

The Smooth Sumac is a very common shrub of dry limestone plains across the Dummer Moraine of southern Ontario, as well as in southwestern Ontario, the Manitoulin Island area and along the international border with Minnesota (Soper and Heimbürger 1982). This curious distribution has no parallel with any other plant species in the province. It is common on the limestone plains in the Warsaw Caves ANSI study area, although it appears to be considered rare east of Toronto by Riley (1989).

[NOTE: A probable hybrid with the widespread Staghorn Sumac (*Rhus typhina* L.) - which was not noted in the study area but which is found in scrubby fields elsewhere in Dummer Township (pers. obs.) - was recorded. Plants with the intermediate characters typical of this hybrid (*Rhus x pulvinata* E. Greene) were observed at the southern end of Quarry Lake beyond the study area boundary by a few meters. They were growing with typical *R. glabra*. This hybrid is rare in Ontario (Soper and Heimbürger (1982) and is unrecorded in Central Region (Riley 1989)].

17) *Parthenocissis quinquefolia* (Woodbine)

[New Peterborough - Durham area record]

A southern vine of rich, alluvial woods and riparian swamps in southern Ontario, this tree-climbing species is rare and supports both introduced (Soper and Heimbürger 1982) and native (Riley 1989; Brunton 1985) populations. Riley (1989) describes it as rare in Central Region, with only a single Simcoe County record from east of the Niagara Escarpment. A small population was observed in the Black Ash - Basswood swamp forest opposite the boat launch (31 D/8 288268).

18) *Viola adunca* (Early Blue Violet)

[New Peterborough - Durham area record]

This is a widespread species of the Boreal regions of Canada, becoming local and confined to calcareous sand and rocky ground in southern Ontario (cf. Morton and Venn 1984; Brunton 1989). It is rare in Central Region (Riley 1989). In the Warsaw Caves ANSI it was found uncommonly in the large open limestone plain area west of the Indian River (31 D/8 287265) and in small clearings along the west shore of Quarry Lake.

19) *Hedeoma hispida* (Mock Penny-royal)

[New Peterborough - Durham area record]

An uncommon midwestern species found in open alvars and limestone plains in southern Ontario (Catling *et al.* 1975; Brunton 1982), this plant is considered rare in Central Region (Riley 1989). It was found in dry, open limestone flats along the west side of Quarry Lake by S. Varga in July 1987; it was not rediscovered during the present study.

20) *Isanthus brachiatus* (False Penny-royal)

[Rare in Central Region]

This tiny mint is a common species of limestone plains and alvars across southern Ontario (Catling *et al.* 1975, Morton & Venn 1984). It is very local in distribution in Central Region (Riley 1989) and considered rare there (S. Varga, pers. comm.). It was found uncommonly throughout the alvar-like limestone plain of Vegetation Type 2 in the Warsaw Caves ANSI.

21) *Scutellaria parvula* (Skull-cap)

[Rare in Central Region]

Like *Isanthus*, above, this southern mint is a common species of limestone plains and alvars across southern Ontario (Catling *et al.* 1975, Morton & Venn 1984), as well as other summer-droughted areas of exposed, calcareous bedrock (pers. obs.). It is very local in distribution in Central Region (Riley 1989) and considered rare there (S. Varga, pers. comm.). It was found uncommonly throughout the alvar-like limestone plain of Vegetation Type 2 in the Warsaw Caves ANSI.

LOCALLY SIGNIFICANT FLORA

A number of species in the study area are uncommon in the general area or, in the case of some introduced taxa, beyond, and are worth highlighting to some degree. They are listed, without further comment, below. Riley (1989) is a useful source for putting these marginally significant taxa of the Warsaw Caves ANSI study area into perspective.

Selaginella rupestris
Pinus resinosa
Carex limosa
Salix candida
Hepatica americana
Myriophyllum heterophyllum
Bidens beckii

3) Significant Fauna

Faunal data were gathered incidentally to floral and vegetational studies. As such, discussions and conclusions in regards to faunal data are preliminary and inconclusive.

Birds

None of the bird species observed in the Warsaw Caves ANSI study area during this investigation, nor those identified for the area during a review of breeding data in Cadman *et al.* (1987) (Appendix B) are considered to be of particular life science significance. In addition, none of the areas and habitats examined during field studies offered clear potential for any breeding species considered significant in southern Ontario (cf. Cadman *et al.* (1987).

Mammals

No significant mammals were observed during this study; the few observations made are supplemented by species for which (1) suitable habitat and (2) the range within which they might normally be expected to be active, are both within the study area (cf. Peterson 1966). A list of observed and expected species is included in Appendix D.

Two significant bat species are tentatively reported from the Warsaw Caves ANSI. Dr. B. Fenton, noted bat expert at York University, is not aware of a proper assessment of the significance of the Warsaw Caves as bat roosting sites and hibernacula but he believes (pers. comm.) that "a few Eastern Pipistrelle" (*Pipistrellus subflavus*) hibernate in one or more of the caves. John G. Woods and P. M. Catling explored a few of the caves in February in the late 1960's and found "lots" of the common Little Brown Bats (*Myotis lucifugus*) and a single specimen of what they believed to be the uncommon Keen's Bat (*Myotis keenii*) (P. Catling, pers. comm.).

Amphibians and Reptiles

No significant amphibians or reptiles were observed during this study, nor could the presence of any be inferred from potential habitat at the study area and reference to literature (Cook 1984; Plourde *et al.* 1988; Weller and Oldham 1988). A list of observed and expected species is included in Appendix D.

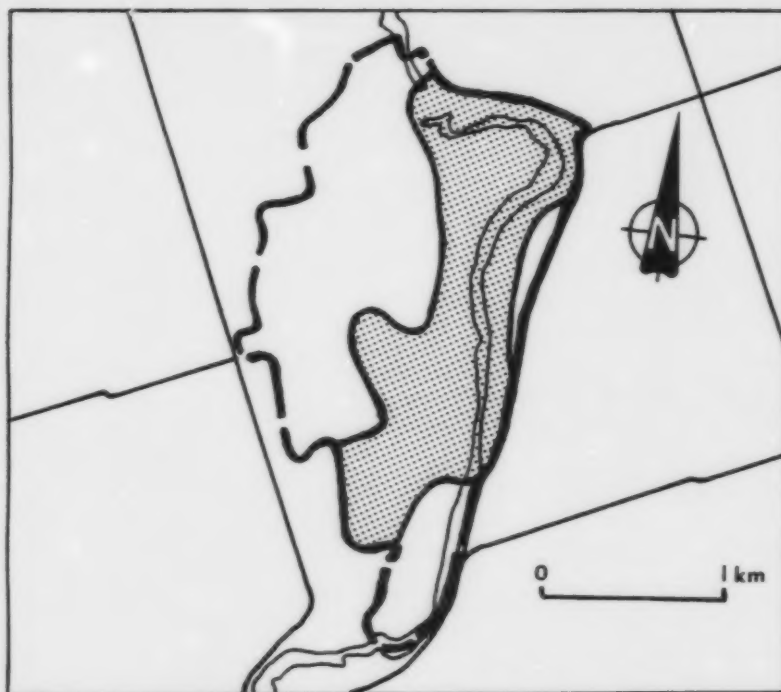
4) Significant Areas

The fen-like sedge meadows are locally significant for the relatively large number of uncommon and regionally significant species they support. The presence of the cliff system which supports the provincially significant Smooth Woodsia (*Woodsia glabella*) station, adds a large measure of importance to the immediate area. That cliff complex, supporting a number of other unusual elements (see Significant Flora) and the only example of limestone woodland cliff vegetation on that scale in Site District 6-9 (see Significant vegetation) contributes yet more significance to the Indian River area here. This complex of landform and vegetation features ends at the site of the Warsaw Caves themselves and the point where the Indian River plunges underground. To this suite of significant features may be added the regionally significant Sugar Maple forest site on either side of the power line west of Quarry Lake.

Reflecting the assemblage of provincially and regionally significant floral, vegetational and landform elements and considering that all of these are contained within a discrete and definable corridor of aesthetically exceptional and relatively natural landscape, a significant core area can be designated in the Warsaw Caves ANSI (Figure 37). This area is delineated more accurately on Map 2 (inside back cover).

A wetlands evaluation was conducted on 16 ha. of fen-like sedge meadows along the Indian River above and below the power line crossing in August 1988 (T. and D. Ostrander, in lit., Otonabee Conservation Authority files) and concluded that this area constituted a Class 2 (Provincially Significant) Wetland. Their evaluation gave the area 540 points. Their evaluation includes a report of two Golden Eagles (on 17 August 1988).

Figure 38: Core Significant Area in the Warsaw Caves ANSI



CHAPTER 4. PLANNING CONSIDERATIONS

1) Evaluation of Life Science Resources

The five criteria utilized to evaluate the ecological significance of ANSI areas (Lindsay 1986; Brunton 1990) are useful in delineating significant areas and features when applied to the entire study area.

Representation

The Sugar Maple forests of Vegetation Type 5 (Mature Deciduous Forest) offer representation of a vegetation poorly represented in the existing ANSI system of Site District 6-9 (Lindsay 1986). The cliff and alvar-like limestone plain (Vegetation Types 3 and 2) also offer representation of an underrepresented landform-vegetation complex in the site district. In this case, for the large cliff sites at least, the areas in the Warsaw Caves ANSI study area appear to be the best examples in Site District 6-9 (cf. Lindsay 1986). The mixed and coniferous upland forests (Vegetation Types 7 and 9) are also considered to be representative of limestone plain vegetation found commonly in the site district (S. Varga, pers. comm.).

Diversity

The Warsaw Caves ANSI study has a wide diversity of upland sites complemented by smaller examples of wetland vegetation types mainly along the Indian River.

Condition

A number of the vegetation types and areas (e.g. the alvar-like limestone plains) are disturbed by human activity. The woodland outcrop and cliff elements, however, appear relatively undisturbed in many areas and completely undisturbed in others (e.g. along the big bend of the Indian River). The southern block of Sugar Maple forest is the most mature but has been affected by manipulation of the tree cover to assist in maple syrup production.

Increasing numbers of private residential development above the cliffs along the east shore of the Indian River north of Quarry Lake and along the west shore of Quarry Lake are having direct, physical impact on some significant outcrop sites and offer potential for greater direct and indirect impact along the Indian River corridor south of the boundaries of the Warsaw Caves Conservation Area.

Run-off of agricultural pollutants and direct fouling of the water by cattle has seriously affected water quality along the Indian River, resulting in the closure of beaches (including the beach in the Warsaw Caves Conservation Area) (Chamberlain and Cockburn (1988). The heavily grazed pasture running to the shore of the Indian River a few meters upstream of the Warsaw Caves Conservation Area swimming beach may be contributing significantly to the problem in the study area.

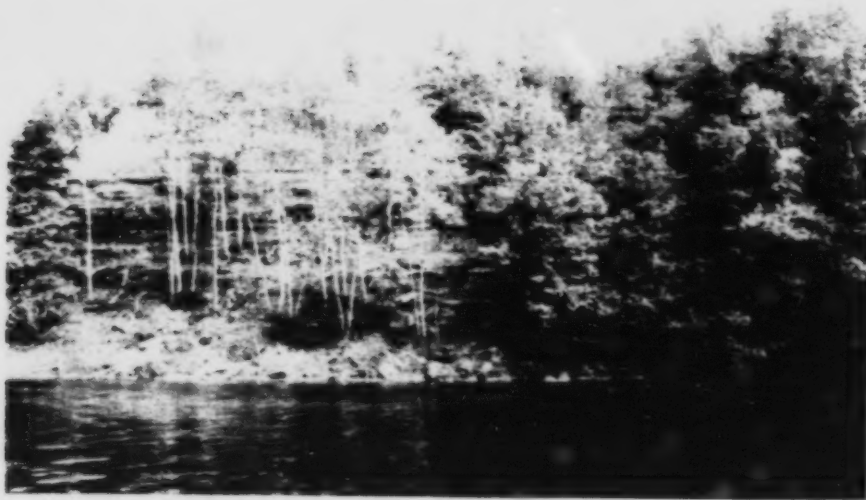
Ecological Considerations

The Warsaw Caves ANSI study is relatively small, although in the context of the severe disturbance of the landscape throughout this part of Peterborough County it is a large natural area. The landform constraint to development along the northern half of Quarry Lake and along the Indian River north of there to the boat launch has protected the important life science features and complexes in this corridor from undue disturbance. Recent clearing of cliff-face forest along the east side of Quarry Lake only a short distance below the *Woodsia glabella* site, however, indicates that this landform constraint can no longer be looked to for protective value (Figure 39).

Special Features

The Significant Features (Chapter 3, page 37) include a provincially significant plant species, 20 regionally significant vascular plants and a potentially provincially (or regionally) significant faunal site (see also Map 2, inside back cover). While these features are found throughout the eastern half of the Warsaw Caves ANSI study area, they are concentrated along the Indian River between the Warsaw Caves and the south end of Quarry Lake.

Figure 39: Clearing of shoreline cliff vegetation along the east shore of Quarry Lake



2) Conclusions

The major conclusions that may be drawn from the findings of this evaluation of the Warsaw Caves ANSI study are as follows:

1. The area of greatest life science significance in the study area is contained within a relatively narrow corridor (ca. 65 ha) along the Indian River between the Warsaw Caves and the south end of Quarry Lake. The vegetation communities there can be considered provincially significant.
2. A second area west of Quarry Lake and on either side of the power line supports an area of Sugar Maple forest, a vegetation type that is underrepresented in Site District 6-9. It can be considered to be regionally significant.
3. The remainder of the Warsaw Caves ANSI study area is composed of young to medium aged, vegetation types commonly found in the site district. They offer a diverse complement to the regionally and provincially significant areas in the core area of the ANSI. These mixed and coniferous forests areas are considered to be of local to regional life science representational significance.
4. Private residential development, such as above the east shore Indian River cliffs, presents a danger to the provincially significant life science values of the upland systems there. The water quality of the Indian River has been declining and this may negatively affect the unusual fen-like sedge meadows north of Quarry Lake.

3) Recommendations

The following recommendations are offered to assist in the on-going effort to protect the significant natural values of the Warsaw Caves ANSI area:

Further Studies

1. A live-trapping (netting) study of the bat populations utilizing the Warsaw Caves should be undertaken as soon as possible to 1) determine population size and species make-up, 2) identify the significance of the Warsaw Caves as a bat roosting site on a regional and provincial basis, and 3) evaluate what impact visitor use of the caves may be having on these populations.²
2. The Moira Karst ANSI, as the other major karst site in (eastern) Site District 6-9 (Lindsay 1986), should be inventoried and compared with the Warsaw Caves ANSI.

² Dr. B. Fenton, York University, suggests (pers. comm.) that "a few nights of netting in August" should be sufficient to assess population size and structure.

Resource Protection

3. Immediate action should be taken to protect the cliff front vegetation of the provincially significant Smooth Woodsia (*Woodsia glabella*) site at the northeast shore of Quarry Lake, preferably by addition of the site to the Warsaw Caves Conservation Area.
4. A co-operative program with the Otonabee Region Conservation Authority, the Ontario Ministry of Natural Resources, the Ontario Ministry of the Environment and local municipalities should be developed to improve water quality along the Indian River and then to maintain it at a reasonable level, in part to protect the sensitive shore vegetation and aquatic natural features in the study area.

Boundaries

5. The regionally significant southern block of Sugar Maple forest should be acquired by the Crown and added to the Warsaw Caves Conservation Area. An interim land management agreement with the owner should be attempted, to protect the significant life science values of the property.

Zoning

6. The portion of the Warsaw Caves ANSI that is contained within the Warsaw Caves Conservation Area should be managed, as much as possible, as nature reserve lands, in its present natural state.

APPENDIX 1: VASCULAR PLANTS OF WARSAW CAVES ANSI

The following lists 371 species of vascular plants recorded in the Warsaw Caves ANSI during this life science inventory. Those names followed by a four digit number (the D. F. Brunton collection number) are represented by voucher specimens collected during the study. All of these are deposited in the herbarium of the Royal Ontario Museum (TRT), except for pteridophyte specimens which have been placed in the herbarium of the University of Guelph (OAC).

Names followed by (**) indicate taxa considered to be introduced to this area by the activities of man.

Nomenclature follows the Central Region Vascular Plant list [Riley *et al.* (1988)]. Departures from that reference are indicated by the Central Region list name being in brackets following the preferred name.

For significant species, the page in the text where the discussion of that species may be found follows the name in square [] brackets.

Voucher specimens (deposited in the Royal Ontario Museum (TRT) and/or the University of Guelph (OAC) herbaria, as appropriate) were made for a number of species. The D. F. Brunton collection number for each of these vouchers (a four digit number commencing with 9___) is noted following the listing, enclosed within regular () brackets.

TAXA	COMMON NAME	STATUS	HABITAT(S)
<u>LYCOPODIACEAE</u>	<u>CLUBMOSS FAMILY</u>		
<i>Huperzia lucidula</i> (Michx.)Trev. (= <i>Lycopodium lucidulum</i>)	Shining Clubmoss	U	6
<i>Lycopodium digitatum</i> A. Br.	Crowfoot Clubmoss	U	6
<i>Lycopodium tristachyum</i> Pursh (9443)	Ground-cedar [page 40]	R	2
<u>SELAGINELLACEAE</u>	<u>SPIKEMOSS FAMILY</u>		
<i>Selaginella eclipses</i> Buck (9422) [page 40]	Northern Meadow Spikemoss	U	14
<i>Selaginella rupestris</i> (L.)Spring (9440)	Rock Spikemoss	R	2
<u>EQUISETACEAE</u>	<u>HORSETAIL FAMILY</u>		
<i>Equisetum arvense</i> L.	Field Horsetail	U	5; 14
<i>Equisetum scirpoides</i> Michx. (9469)	Dwarf Scouring-rush	R	7
<u>OPHIOGLOSSACEAE</u>	<u>ADDER'S-TONGUE FAMILY</u>		
<i>Botrychium virginianum</i> (L.)Sw.	Rattlesnake Fern	C	7

OSMUNDACEAE

Osmunda cinnamomea L.
Osmunda regalis L.

ADIANTACEAE

Cryptogramma stelleri (Gmel.) Prantl.
 (9454) [page 41]

POLYPODIACEAE

Polypodium virginianum L.

DENNSTAEDTIACEAE

Pteridium aquilinum (L.) Kuhn

THELYPTERIDACEAE

Thelypteris palustris (Salisb.) Schott

ASPLENIACEAE

Asplenium rhizophyllum L.
 (= *Camptosorus rhizophyllus*) [page 40]
Asplenium trichomanes L. (9409)

Athyrium filix-femina (L.) Roth

Cystopteris bulbifera (L.) Bernh.
Cystopteris fragilis (L.) Bernh. var. *fragilis*

Dryopteris carthusiana (Vill.) Fuchs
Dryopteris cristata (L.) Gray (9466)
Dryopteris intermedia (Muhl.) Gray
Dryopteris marginalis (L.) Gray

Matteuccia struthiopteris (L.) Todaro

Onoclea sensibilis L.

Woodsia glabella R. Br. (9406) [page 37]

ROYAL FERN FAMILY

Cinnamon Fern U 11
 American Royal Fern R 14

MAIDENHAIR FERN FAMILY

Slender Cliff-brake R 3

POLYPODY FAMILY

Rock Polypody C 3

BRACKEN FAMILY

Eastern Bracken C 2; 4; 5; 7; 8; 9

BEECH FERN FAMILY

Marsh Fern C 13; 14

SPLEENWORT FAMILY

Walking Fern C 2; 7
 Maidenhair Spleenwort C 2; 7

Northeastern Lady Fern R 6

Bulblet Fern C 3; 7; 9; 11
 Northern Fragile Fern U 3

Spinulose Wood Fern R 10
 Crested Wood Fern R 10
 Glandular Wood Fern U 6; 8
 Marginal Wood Fern C 2; 7; 9

American Ostrich Fern U 10; 11

Sensitive Fern R 11

Smooth Woodsia R 3

TAXACEAE*Taxus canadensis* Marsh.PINACEAE*Abies balsamea* (L.) Mill.*Larix laricina* (Du Roi) K. Koch*Picea glauca* (Moench) Voss*Pinus resinosa* Ait.*Pinus strobus* L.*Tsuga canadensis* L.CUPRESSACEAE*Juniperus communis* L.*Juniperus virginiana* L.*Thuja occidentalis* L.TYPHACEAE*Typha latifolia* L.SPARGANIACEAE*Sparganium americanum* Nutt.POTAMOGETONACEAE*Potamogeton epihydrus* Raf.*Potamogeton illinoensis* Morong [page 41]*Potamogeton pectinatus* L.*Potamogeton strictifolius* A. Benn. (9424)*Potamogeton zosteriformis* Fern.ALISMATACEAE*Sagittaria latifolia* Willd.YEW FAMILY

American Yew

PINE FAMILY

Balsam Fir

Tamarack

White Spruce

Red Pine

White Pine

Eastern Hemlock

CYPRESS FAMILY

Common Juniper

Red Cedar

White Cedar

CATTAIL FAMILY

Common Cattail

BUR-REED FAMILY

Nuttall's Bur-reed

PONDWEED FAMILY

Pondweed

Pondweed

Sago Pondweed

Pondweed [page 41]

Flat-stemmed Pondweed

WATER-PLANTAIN FAMILY

Common Arrowhead

C 6; 7

C 7; 8; 9; 10

R 14

C 6; 7; 8; 11

R 7

C 6; 7; 8

U 6

C 2; 4

U 2; 4

C 2; 4; 5; 7; 9; 10

U 12; 13; 14

U 12; 13; 15

C 15

C 15

U 15

C 15

U 15

U 14; 15

NAJADACEAE*Najas flexilis* (willd.) R.& S.HYDROCHARITACEAE*Elodea canadensis* Michx.*Vallisneria americana* Michx.POACEAE*Agropyron repens* (L.)Beauv.***Agrostis gigantea* Roth ***Agrostis stolonifera* L.*Agrostis scabra* Willd.*Bromus ciliatus* L.*Bromus inermis* Leyss.***Calamagrostis canadensis* (Michx.)Nutt.*Dactylis glomerata* L.***Danthonia spicata* (L.)Beauv.*Dichanthelium acuminatum* (Swartz)Gould & Clarke
var. *acuminatum**Digitaria ischaemum* (Schreb.)Muhl.***Echinochloa crusgalli* (L.)Beauv.***Echinochloa weigandii* (Fassett)
McNeill & Dore*Elymus hystrix* L.*Elymus virginicus* L.*Eragrostis minor* Host***Glyceria striata* (Lam.)Hitchc.*Leersia oryzoides* (L.)Sw.*Muhlenbergia glomerata* (Willd.)Trin.*Muhlenbergia mexicana* (L.)Trin.*Oryzopsis asperifolia* Michx.NAIAD FAMILY

Bush Naiad

U 15

FROG'S-BIT FAMILY

Water-weed

C 15

Tape Grass

U 15

GRASS FAMILY

Quack Grass

C 1; 2; 4

Redtop

C 1; 2

Creeping Bent Grass

U 5

Ticklegrass

R 2

Fringed Brome Grass

U 5; 14

Smooth Brome Grass

C 1; 2; 4

Canada Blue-joint

U 14

Orchard Grass

U 1

Poverty Oat-grass

C 1; 2; 4

Clarke

Panic Grass

U 7

Smooth Crabgrass

U 1

Barnyard Grass

U 1

Western Barnyard Grass

R 1

Bottle-brush Grass

R 10

Virginia Wild-rye

R 10

Little Love Grass

R 1

Fowl Manna Grass

U 10

Cut Grass

C 13; 14

Muhly Grass

U 14

Muhly Grass

C 7; 9; 13; 14

Rough-leaved Mountain-rice

R 6

<i>Panicum capillare</i> L.	Witch Grass	C	1
<i>Panicum philadelphicum</i> Bernh. (9405A; 9420) [page 42]	Panic Grass	C	2
<i>Phalaris arundinacea</i> L.	Reed Canary Grass	U	14
<i>Phleum pratense</i> L. **	Timothy	C	1; 2
<i>Poa annua</i> L.**	Annual Blue Grass	U	1
<i>Poa compressa</i> L.**	Canada Blue Grass	C	1; 2; 3; 5
<i>Poa palustris</i> L.	Fowl Manna Grass	R	10
<i>Poa pratensis</i> L.	Kentucky Blue Grass	C	1; 5
<i>Schizachne purpurascens</i> (Torr.)Sw.	False Melic Grass	R	6
<i>Setaria glauca</i> (L.)Beauv. **	Yellow Foxtail	C	1
<i>Setaria viridis</i> (L.)Beauv.** (9477)	Green Foxtail	R	1
<i>Sporobolus neglectus</i> Nash	Overlooked Dropseed	U	1
<i>Sporobolus vaginiflorus</i> (Torr.)Wood	Ensheathed Dropseed	U	1; 2

CYPERACEAE

Carex aquatilis Wahl.
Carex arctata Boott
Carex aurea Nutt.
Carex communis Bailey
Carex comosa Boott
Carex eburnea Boott
Carex flava L.
Carex gracillima Schw.
Carex interior Bailey (9449)
Carex intumescens Rudge
Carex lasiocarpa Ehrh.
Carex limosa L.
Carex pedunculata Willd.
Carex pennsylvanica Lam.
Carex retrorsa Schw.
Carex stipata Willd.
Carex utriculata Boott
Carex vulpinoidea Michx.

Cyperus rivularis Kunth

Eleocharis acicularis (L.)R.& S.
Eleocharis palustris (L.)R.& S.

Scirpus atrovirens Willd.
Scirpus cyperinus (L.)Kunth
Scirpus lacustris L.
Scirpus microcarpus Presl.

SEDGE FAMILY

Sedge U 13; 14
 Sedge U 6
 Sedge U 13; 14
 Sedge U 6
 Sedge C 13; 14
 Sedge C 2; 7; 9
 Sedge U 14
 Sedge R 6
 Sedge U 13; 14
 Sedge R 10
 Sedge C 13; 14
 Sedge R 14
 Sedge U 6
 Sedge C 6; 8; 9
 Sedge R 12
 Sedge U 10; 12
 Sedge R 14
 Sedge R 12

Nut Grass R 14
 Spike-rush R 14
 Spike-rush U 14; 15

Black Bulrush R 12
 Wool-grass U 10; 12
 Softstem Bulrush U 15
 Bulrush R 10

ARACEAE*Arisaema triphyllum* (L.) SchottLEMNACEAE*Lemna minor* L.JUNCACEAE*Juncus articulatus* L.*Juncus dudleyi* Wieg.*Juncus tenuis* Willd.LILIACEAE*Allium tricoccum* Ait.*Erythronium americanum* Ker.*Maianthemum canadense* Desf.
var. *canadense**Smilacina racemosa* (L.) Desf.*Trillium erectum* L.*Trillium grandiflorum* (Michx.) Salisb.*Uvularia grandiflora* Sm.IRIDACEAE*Iris versicolor* L.ORCHIDACEAE*Epipactis helleborine* (L.) Crantz ***Liparis loeselii* (L.) Rich. (9432)*Spiranthes lacera* Raf.ARUM FAMILY

Jack-in-the-pulpit

R

10

DUCKWEED FAMILY

Common Duckweed

U

14; 15

RUSH FAMILY

Rush

U

14

Rush

14

Path Rush

U

16; 8; 9

LILY FAMILY

Wild Leek, Ramps

R

6

Yellow Trout-lily

C

6

Wild Lily-of-the-valley

C

2; 6; 7; 9

False Solomon's-seal

U

6; 8

Purple Trillium, Stinking
Benjamin

U

6; 10

Common Trillium

C

6

Bellwort

U

6

IRIS FAMILY

Wild Blue Flag

U

14

ORCHID FAMILY

Helleborine

U

6; 7

Loesel's Twayblade

U

14

Northern Slender Ladies'-
tresses

R

2

SALICACEAE

Populus alba L. **
Populus grandidentata Michx.
Populus tremuloides Michx.

Salix bebbiana Sarg.
Salix candida Flügge (9431)
Salix petiolaris Sm.

MYRICACEAE

Myrica gale L.

JUGLANDACEAE

Carya cordiformis (Wang)K. Koch

Juglans cinerea L.

BETULACEAE

Alnus rugosa (Du Roi)Spreng.

Betula alleghaniensis Britt.
Betula papyrifera Marsh.

Carpinus caroliniana Walt.

Ostrya virginiana (Mill.)K.Koch

FAGACEAE

Fagus grandifolia Ehrh.

Quercus rubra L.
Quercus macrocarpa Michx.

ULMACEAE

Ulmus americana L.
Ulmus rubra Muhl.

WILLOW FAMILY

White Poplar	R	1
Large-toothed Aspen	U	8; 9
Trembling Aspen	U	12; 9
Beaked Willow, Bebb's Willow	R	12; 13
Hoary Willow	R	14
Slender Willow	R	12; 13

BAYBERRY FAMILY

Sweet Gale	C	13; 14
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WALNUT FAMILY

Bitternut Hickory	R	6
Butternut	R	9

BIRCH FAMILY

Speckled Alder	C	10; 11; 12; 14
Yellow Birch	U	6; 10
White Birch	U	2; 3; 9
Blue Beach	U	6
Ironwood	U	6

BEECH FAMILY

American Beech	U	6
Red Oak	U	6
Bur Oak	U	10

ELM FAMILY

White Elm	C	2; 10
Red or Slippery Elm	R	2

URTICACEAE

- Boehmeria cylindrica* (L.) Sw.
Laportea canadensis (L.) Wedd.
Urtica dioica L.
 ssp. *gracilis* (Ait.) Selander
Urtica urens L. **

POLYGONACEAE

- Polygonum arenastrum* Boreau ** (10464)
Polygonum cilinode Michx.
Polygonum hydropiper L.

Rumex crispus L. **
Rumex orbiculatus L.

CHENOPODIACEAE

- Chenopodium album* L. **

CARYOPHYLLACEAE

- Arenaria serpyllifolia* L. **

Cerastium arvense L. (9419) [page 42]
Cerastium fontanum Baumg. **

Minuartia michauxii (Fenzl) Farw. (9439)
 (= *Arenaria stricta*)

Saponaria officinalis L. **

Silene vulgaris (Moench) Garcke **

CERATOPHYLLACEAE

- Ceratophyllum demersum* L.

NYMPHAEACEAE

- Nuphar variegatum* Engelm.

Nymphaea odorata Ait.

NETTLE FAMILY

- False Nettle R 10

Wood Nettle R 10

American Stinging Nettle U 10; 14
Annual Nettle

BUCKWHEAT FAMILY

- Prostate Knotweed R 1
Fringed Buckwheat U 1
Marshpepper Smartweed R 14

Curly Dock U 1
Great Water Dock U 15

SPINACH FAMILY

- Lamb's-quarters, Pigweed R 1; 3

PINK FAMILY

- Thyme-leaved Sandwort C 2

Field Chickweed C 2
Mouse-eared Chickweed C 1

Rock Sandwort [page 42] U 1; 2

Bouncing-bet, Soapwort U 1

Bladder Campion C 1

HORNWORT FAMILY

- Common Coontail C 15

WATER-LILY FAMILY

- Bulhead Lily U 15

Fragrant Water-lily C 15

RANUNCULACEAE

<i>Actaea pachypoda</i> Ell.
<i>Actaea rubra</i> (Ait.) Willd.
<i>Anemone cylindrica</i> Gray.
<i>Anemone virginiana</i> L.
<i>Aquilegia canadensis</i> L.
<i>Clematis virginiana</i> L.
<i>Hepatica acutiloba</i> DC.
<i>Hepatica americana</i> (DC.) Ker. (9470)
<i>Ranunculus acris</i> L. **
<i>Ranunculus recurvatus</i> Poir.
<i>Thalictrum dioicum</i> L.
<i>Thalictrum pubescens</i> Pursh

BERBERIDACEAE

<i>Caulophyllum thalictroides</i> (Farw.) Loc. & Black. var. <i>giganteum</i> Farw.
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BRASSICACEAE

<i>Arabis divaricarpa</i> Nels.
<i>Arabis pycnocarpa</i> Hopkins (9408) [page 42] (= <i>Arabis hirsuta</i> var. <i>pycnocarpa</i>)
<i>Cardaria draba</i> (L.) Desv. **
<i>Nasturtium officinale</i> R. Br. **

CRASSULACEAE

<i>Sedum acre</i> L. **

SAXIFRAGACEAE

<i>Saxifraga virginiana</i> Michx.
<i>Tiarella cordifolia</i> L.

CROWFOOT FAMILY

White Doll's-eye	C	6
Red Baneberry	U	7
Long-fruited Anemone	U	2; 7
Thimbleweed	C	2; 8
Wild Columbine	C	2
Virgin's-bower	U	13; 14
Sharp-lobed Hepatica	U	6
Round-lobed Hepatica	R	6
Tall Buttercup	C	2; 5
Hooked Buttercup	R	6
Early Meadow Rue	U	6
Tall Meadow Rue	C	12; 14

BARBERRY FAMILY

Blue Cohosh	U	6
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MUSTARD FAMILY

Rock-cress	R	3
Rock-cress	U	2
Hoary Cress	R	1
Water Cress	R	14

ORPINE FAMILY

Mossy Stoncrop	C	1; 2
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SAXIFRAGE FAMILY

Early Saxifrage	U	2
Foam Flower	U	9

GROSSULARIACEAE

Ribes americanum Mill.
Ribes glandulosum Grauer
Ribes lacustre (Pers.)Poir. [page 42]

ROSACEAE

Agrimonia gryposepala Wallr.

Crataegus chrysocarpa Ashe
Crataegus punctata Jacq.

Fragaria virginiana Duchesne

Geum aleppicum Jacq.
Geum canadense Jacq.

Malus pumila L. **

Potentilla argentea L.
Potentilla inclinata Vill. ** (9421)
Potentilla norvegica L.
Potentilla recta L. **
Potentilla simplex Michx.

Prunus nigra Ait.
Prunus serotina Ehrh.
Prunus virginiana L.

Rosa acicularis Lindl. [page 43]
Rosa blanda Ait.
Rosa palustris Marsh.

Rubus allegheniensis Porter
Rubus odoratus L.
Rubus pubescens Raf.
Rubus strigosus Michx.

Spiraea alba DuRoi
 var. *alba*

FABACEAE

Lotus corniculatus L. **

Medicago lupulina L. **
Medicago sativa L. **

GOOSEBERRY FAMILY

Wild Black Currant R 10
 Skunk Currant R 10
 Swamp Black Currant R 10

ROSE FAMILY

Agrimony R 10

Hawthorn R 2
 Dotted Hawthorn R 2

Common Strawberry C 1; 2; 57; 8

Yellow Avens U 10; 14
 White Avens R 10

Domestic Apple U 5

Silverweed R 2
 Downy Cinquefoil R 2
 Rough Cinquefoil C 1; 5
 Rough-fruited Cinquefoil C 1; 2
 Common or Old-field Cinquefoil

Canada Plum R 4
 Wild Black Cherry U 6; 8
 Chokecherry C 2; 5; 8; 10

Wild Rose R 2
 Wild Rose R 2
 Swamp Rose R 14

Common Blackberry R 7
 Flowering Raspberry U 6; 7; 8
 Dwarf Raspberry R 6
 Wild Red Raspberry C 8

Meadowsweet C 10; 14

PEA FAMILY

Bird-foot Trefoil U 1

Black Medic U 1
 Alfalfa U 1

Melilotus alba Desr. ** (9475)
Melilotus officinalis (L.) Desr. ** (9476)

Trifolium aureum Poll. **
Trifolium hybridum L. **
Trifolium repens L. **

Vicia cracca L. **

GERANIACEAE

Geranium bicknellii Britt
Geranium robertianum L.

OXALIDACEAE

Oxalis fontana Bunge
Oxalis stricta L.

RUTACEAE

Zanthoxylum americanum Mill. [page 43]

POLYGALACEAE

Polygala paucifolia Willd. (9423)

EUPHORBIACEAE

Euphorbia maculata L.
Euphorbia vermiculata Raf.

CALLITRICHACEAE

Callitriche verna L. [page 43]

ANACARDIACEAE

Rhus glabra L. [page 43]
Toxicodendron rydbergii (Rydb.) Greene

White Sweet-clover
 Yellow Sweet-clover

Hop Clover
 Alsike Clover
 White Clover

Bird Vetch

GERANIUM FAMILY

Cransbill
 Herb Robert

WOOD-SORREL FAMILY

Wood-sorrel
 Common Wood-sorrel

RUE FAMILY

Prickly-ash

MILKWORT FAMILY

Fringed Polygala

SPURGE FAMILY

Hairy-fruited Spurge
 Hairy-stemmed Spurge

WATER-STARWORT FAMILY

Water-starwort

CASHEW FAMILY

Smooth Sumac
 Poison-ivy

C	1
U	1
C	1
U	1
C	4; 8; 9
C	1; 5

U	2
C	6; 8; 9

U	1
C	1; 2

U	2; 10
---	-------

C	7; 8
---	------

R	1; 2
U	1

R	15
---	----

C	2
C	1; 2; 3; 4; 5; 7; 8; 9; 10; 11

CELASTRACEAE

Celastrus scandens L.

ACERACEAE

Acer rubrum L.

Acer saccharinum L.

Acer saccharum Marsh.

Acer spicatum Lam.

BALSAMINACEAE

Impatiens capensis Meerb.

RHAMNACEAE

Rhamnus alnifolius L'Her

VITACEAEParthenocissus quinquefolius (L.)Planch
(L.)Planch (9442) [page 44]

Parthenocissus vitacea (Knerr)Hitchc.

Vitis riparia Michx.

TILIACEAE

Tilia americana L.

CLUSIACEAE

Hypericum perforatum L. **

Triadenum fraseri (Spach)Gl.

VIOLACEAE

Viola adunca Sm. [page 45]

Viola canadensis L.

Viola cucullata Ait.

Viola pubescens Ait.

STAFF-TREE FAMILY

Climbing Bittersweet

C

4; 7

MAPLE FAMILY

Red Maple

C

8; 9

Silver Maple

U

11

Sugar Maple

C

6; 8

Mountain Maple

C

8

TOUCH-ME-NOT FAMILYSpotted Jewelweed,
Touch-me-not

C

10; 11; 12; 15

BUCKTHORN FAMILY

Alder-leaved Buckthorn

U

11

GRAPE FAMILY

Virginia Creeper

R

11

Virginia Creeper

C

2; 8; 11

Riverbank Grape

C

5; 14; 15

LINDEN FAMILY

Basswood

C

67; 8

ST. JOHN'S-WORT FAMILY

Common St. John's-wort

C

1; 2

Marsh St. John's-wort

C

13; 14; 15

VIOLET FAMILY

Stemless Blue Violet

C

2

Canada Violet

U

6

Marsh Violet

R

6

Downy Yellow Violet

U

6; 8

THYMELAECEAE*Dirca palustris* L.ELAEAGNACEAE*Shepherdia canadensis* (L.) Nutt.LYTHRACEAE*Lythrum salicaria* L. **ONAGRACEAE*Circaea alpina* L.*Circaea luteianana* L.*Epilobium ciliatum* Raf.ssp. *glandulosum* (Lehm) Hoch & Raven*Epilobium leptophyllum* Raf.*Ludwigia palustris* (L.) Ell.*Oenothera parviflora* L.HALORAGIDACEAE*Myriophyllum heterophyllum* Michx. (9410)*Myriophyllum spicatum* L. **ARALIACEAE*Aralia nudicaulis* L.*Aralia racemosa* L.APIACEAE*Cicuta bulbifera* L.*Daucus carota* L. ***Osmorhiza claytonii* (Michx.) Clarke*Sanicula marilandica* L.MEZEREUM FAMILY

Leatherwood

U

6

OLEASTER FAMILY

Soapberry, Buffaloberry

C

2; 7

LOOSESTRIFE FAMILY

Purple Loosestrife

R

14

EVENING-PRIMROSE FAMILY

Small Enchanter's Nightshade

R

10

Enchanter's Nightshade

C

7; 10

Sticky Willowherb

R

10

Willowherb

U

14

False Loosestrife

R

14

Small-flowered Evening-
primrose

C

1; 5

WATER MILFOIL FAMILY

Water Milfoil

U

15

Eurasian Water-milfoil

C

15

GINSENG FAMILY

Wild Sarsaparilla

C

2; 6; 7

Spikenard

U

7

CARROT FAMILY

Bulbous Water-hemlock

C

13; 14

Wild Carrot, Queen Anne's
Lace

C

Sweet Cicely

U

6; 8

Black Snakeroot

U

8; 9

CORNACEAE

Cornus alternifolia L.f.
Cornus amomum Raf.
Cornus foemina Mill.
Cornus rugosa Lam.
Cornus stolonifera Michx.

DOGWOOD FAMILY

Alternate-leaved Dogwood	R	9
Silky Dogwood	U	13
Grey Dogwood	R	5
Round-leaved Dogwood	U	2; 9
Red-osier Dogwood	C	10;11;12;13;14

PYROLACEAE

Orthilia secunda (L.)House

WINTERGREEN FAMILY

One-sided Pyrola or Wintergreen	R	6
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ERICACEAE

Arctostaphylos uva-ursi (L.)Spreng.

HEATH FAMILY

Bearberry	C	2; 7
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PRIMULACEAE

Lysimachia ciliata L.

PRIMROSE FAMILY

Fringed Loosestrife	R	10
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OLEACEAE

Fraxinus americana L.
Fraxinus nigra Marsh.
Fraxinus pennsylvanica Marsh.

OLIVE FAMILY

White Ash	U	2; 9
Black Ash	C	10; 11
Red Ash	U	10

GENTIANACEAE

Gentiana andrewsii Griseb. (9468)

GENTIAN FAMILY

Closed Gentian	U	8; 14
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ASCLEPIADACEAE

Asclepias incarnata L.
Asclepias syriaca L. (9404B)

MILKWEED FAMILY

Swamp Milkweed	C	12; 13; 14
Common Milkweed	C	1; 2; 5

CONVOLVULACEAE

Convolvulus arvensis L. **

MORNING GLORY FAMILY

Field Bindweed	R	14
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HYDROPHYLLACEAE

Hydrophyllum virginianum L.

WATERLEAF FAMILY

Virginia Waterleaf	R	8
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BORAGINACEAE

- Echium vulgare* L. **
Hackelia deflexa (Wahl.)Opiz

VERBENACEAE

- Verbena hastata* L.

LAMIACEAE

- Acinos arvensis* (Lam.)Dandy (9446)
Hedeoma hispida Pursh [page 44]
Isanthus brachiatus (L.)BSP. [page 44]
Leonurus cardiaca L. **
Lycopus americanus Muhl.
Lycopus uniflorus Michx. (9474)
Mentha arvensis L.
Monarda fistuosa L. (9438)
Nepeta cataria L. **
Prunella vulgaris L. **
Satureja vulgaris (L.)Fritsch
Scutellaria parvula Michx. (9447)

SOLANACEAE

- Physalis heterophylla* Nees
Solanum dulcamara L. **

SCROPHULARIACEAE

- Agalinis paupercula* (Gray)Britt. (9414)
Chelone glabra L.
Linaria vulgaris Mill **

BORAGE FAMILY

- Blueweed, Viper's-bugloss C 1; 2; 5
 Stickseed, Beggar's-lice U 10

VERVAIN FAMILY

- Blue Vervain U 11; 14

MINT FAMILY

- Savory R 2
 Mock Pennyroyal R 2 (SV)
 False Pennyroyal U 2
 Motherwort R 6
 American Water-horehound R 11
 Water hore-hound C 12; 13
 Field or Common Mint U 10; 14
 Wild Bergamot C 2
 Catnip C 1; 2
 Heal-all U 2
 Dogmint C 1; 2
 Skullcap U 2

NIGHTSHADE FAMILY

- Clammy Ground-cherry R 1
 Bittersweet U 1; 10

FIGWORT FAMILY

- Agalinus* C 12; 14
 Turtlehead C 12; 13; 14
 Toadflax, Butter-and-eggs C 1; 2

<i>Mimulus ringens</i> L.	Square-stemmed Monkeyflower		C13; 14
<i>Penstemon hirsutus</i> (L.) Willd.	Beard-tongue	C	2; 7
<i>Veronica americana</i> (Raf.) Schwein. (9437; 9465)	American Brooklime	R	14
<i>Veronica anagallis-aquatica</i> L. **	Water-speedwell	R	14
<i>Veronica officinalis</i> L. **	Common Speedwell	R	7
<i>Veronica serpyllifolia</i> L. **	Thyme-leaved Speedwell	R	10

PHRYMACEAE

Phryma leptostachya L.

LOPSEED FAMILY

Lopseed R 7

PLANTAGINACEAE

Plantago major L. **
Plantago rugelii Dcne.

PLANTAIN FAMILY

Broad-leaved Plantain C 1
Rugel's Plantain R 6

RUBIACEAE

Galium obtusum Bigel.
Galium palustre L.
Galium triflorum Michx.

MADDER FAMILY

Bedstraw R 14
Marsh Bedstraw U 12; 14
Sweet-scented Bedstraw U 6; 8

CAPRIFOLIACEAE

Diervilla lonicera Mill.
Linnaea borealis L. (9472)
Lonicera canadensis Bart. ex Marsh.
Sambucus racemosa L.
Symphoricarpos albus (L.) Blake
Viburnum opulus L.
var. *americanus* Ait.

HONEYSUCKLE FAMILY

Bush-honeysuckle R 2
Twinflower R 6
Fly-honeysuckle U 6
Red-berried Elder U 6; 9
Snowberry U 2; 7
Guelder-rose R 10

CAMPANULACEAE

Campanula aparinoides Pursh
Campanula rapunculoides L. **
Campanula rotundifolia L.

BLUEBERRY FAMILY

Marsh-bellflower U 14
Creeping Bellflower R 1
Harebell U 2; 3

LOBELIACEAE

Lobelia cardinalis L.
Lobelia inflata L.

LOBELIA FAMILY

Cardinal Flower R 10
 Indian Tobacco U 6; 10

ASTERACEAE

Achillea millefolium L.
Ambrosia artemisiifolia L.
Anaphalis margaritacea (L.) Benth. & Hook.
Antennaria neglecta Greene
Antennaria neodioica Greene
 ssp. *neodioica*
Arctium minus Bernh. **
Artemisia biennis L. **
Aster ciliolatus Lindl.
Aster cordifolius L.
Aster lanceolatus Willd.
Aster lateriflorus (L.) Britt.
Aster macrophyllus L.
Aster puniceus L.
Aster umbellatus Mill.
Bidens beckii Torr. (9415)
Bidens cernua L.
Bidens frondosa L.
Carduus nutans L. **
Centaurea maculosa Lam. **
Chrysanthemum leucanthemum L. **
Cichorium intybus L. **
Cirsium arvense (L.) Scop. **
Cirsium vulgare L. **
Conyza canadensis (L.) Cronq. **
Erigeron annuus (L.) Pers.
Erigeron strigosus Muhl.
Eupatorium maculatum L.
Eupatorium perfoliatum L.

ASTER FAMILY

Yarrow C 1; 2; 5
 Common Ragweed U 1
 Pearly Everlasting U 7
 Pussytoes U 2
 Pussytoes U 1; 2
 Common Burdock C 1
 Biennial Wormwood R 1
 Aster C 2; 7
 Heart-leaved Aster C 2; 7
 Tall White Aster C 4; 13; 14
 One-sided Aster U 10; 13
 Large-leaved Aster C 6; 8, 9
 Red-stemmed Aster C 9; 10; 13
 Flat-topped White Aster R 14
 Marsh Beggarticks U 15
 Nodding Beggarticks U 12; 14
 Devil's Beggarticks C 12; 14
 Nodding Thistle C 1
 Spotted Knapweed R 1
 Ox-eye Daisy C 1
 Chicory R 1
 Canada Thistle C 1
 Bull Thistle U 1
 Horse-weed U 1
 Annual Fleabane U 1
 Rough Fleabane C 2
 Spotted Joe-Pye Weed C 10; 12; 14
 Boneset U 12; 14

<i>Eupatorium rugosum</i> Houtt.	White Snakeroot	C	7; 10
<i>Euthamia graminifolia</i> (L.)Nutt.	Narrow-leaf Goldenrod	C	12; 14
<i>Helianthus</i> (cf.) <i>tuberosus</i> L. ** (9473)	Jerusalem Artichoke	R	1
<i>Hieracium piloselloides</i> Vill. **	King Devil Hawkweed	C	1; 2; 5
<i>Lactuca biennis</i> (Moench)Fern.	Tall Blue Lettuce	U	8
<i>Matricaria matricarioides</i> (Less.)Porter **	Pineapple Weed	U	1
<i>Prenanthes alba</i> L. (9419)	White Lettuce, Rattlesnake-root	R	6
<i>Senecio pauperculus</i> Muhl.	Balsam Ragwort	C	2
<i>Solidago altissima</i> L.	Tall Goldenrod	R	2
<i>Solidago caesia</i> L.	Blue-stem Goldenrod	R	7
<i>Solidago canadensis</i> L.	Canada Goldenrod	C	2; 5
<i>Solidago flexicaulis</i> L. (9419)	Zig-zag Goldenrod	C	6
<i>Solidago gigantea</i> Ait.	Late Goldenrod	U	5
<i>Solidago hispida</i> Muhl.	Hairy Goldenrod	C	2; 4
<i>Solidago juncea</i> Ait.	Early Goldenrod	U	4
<i>Solidago nemoralis</i> Ait.	Gray Goldenrod	C	2; 4;
<i>Solidago rugosa</i> Mill.	Rough Goldenrod	U	10; 14
<i>Sonchus arvensis</i> L. **	Perennial Sow-thistle	C	1
<i>Sonchus oleraceus</i> L. **	Annual Sow-thistle	R	1
<i>Tanacetum vulgare</i> L. **	Tansy	R	1
<i>Taraxacum officinale</i> Weber **	Dandelion	C	1; 2
<i>Tragopogon pratensis</i> L. **	Meadow Goat's-beard	U	5
<i>Virgulus ericoides</i> (L.)Rev.& Keen. (9416)	Heath Aster	U	2
<i>Virgulus novae-angliae</i> (L.)Rev.& Keen.	New England Aster	2; 5	

APPENDIX 2: BIRD SPECIES OBSERVED IN THE WARSAW CAVES ANSI

The following lists the species of birds observed during the September 1989 life science inventory of the Warsaw Caves ANSI. Nomenclature and species order follows Godfrey (1986).

Great Blue Heron
Green-backed Heron

Mallard

Osprey
Sharp-shinned Hawk
Red-tailed Hawk

Ruffed Grouse

Killdeer

Ring-billed Gull

Mourning Dove

Belted Kingfisher

Downy Woodpecker
Hairy Woodpecker
Northern Flicker

Great Crested Flycatcher
Eastern Kingbird

Tree Swallow
Bank Swallow

Blue Jay
American Crow

Black-capped Chickadee

White-breasted Nuthatch

Brown Creeper

Golden-crowned Kinglet

American Robin

Gray Catbird
Brown Thrasher

Cedar Waxwing

European Starling

Warbling Vireo
Red-eyed Vireo

Nashville Warbler
Chestnut-sided Warbler
Magnolia Warbler
Black-throated Blue Warbler
Yellow-rumped Warbler
Black-throated Green Warbler
Blackburnian Warbler
Bay-breasted Warbler
Black and White Warbler
American Redstart
Common Yellowthroat

Rose-breasted Grosbeak

Song Sparrow
Swamp Sparrow
White-throated Sparrow

Common Grackle

Purple Finch

APPENDIX 3: MAMMALS OF THE WARSAW CAVES ANSI

Few mammals species were actually seen during the September 1989 life science inventory of the Warsaw Caves ANSI study area. Accordingly, to provide a more meaningful set of data a list has been compiled of species that contain the study area within their range and for which suitable habitat exists within the study area. In other words, species likely to be found here following more detailed examination of the mammal fauna. This list is generated from Peterson (1966) and follows his order and nomenclature.

Species observed during this study are underlined; **bold face** indicates significance species. The number in brackets following significant species listings indicates the page in the text where that species is discussed.

Masked Shrew

Smoky Shrew

Big Short-tailed Shrew

Star-nosed Mole

Little Brown Bat

Keen's Bat (*fide*, J. G. Woods & P. Catling)
(page 45)

Pipistrelle Bat (*fide*, B. Fenton) (page 45)

Big Brown Bat

European Hare

Cottontail Rabbit

Gray Squirrel

Red Squirrel

Woodchuck

Eastern Chipmunk

Northern Flying Squirrel

Beaver

Muskrat

Deer Mouse

White-footed Mouse

Meadow Vole

Meadow Jumping Mouse

Porcupine

Coyote

Red Fox

Raccoon

Ermine

Mink

Striped Skunk

APPENDIX 4: AMPHIBIANS AND REPTILES OF THE WARSAW CAVES ANSI

Few amphibian and reptiles were observed during the September 1989 life science inventory of the Warsaw Caves ANSI study area. So as to provide a more meaningful set of data, a list has been compiled of species that contain the study area within their range and for which suitable habitat exists within the study area. In other words, species likely to be found here following more indepth examination of the herptofauna fauna. This list is generated from Weller and Oldham (1988) and Cook (1984) and follows their order and nomenclature.

Species observed during this study³ are underlined.

Red-spotted Newt
Jefferson Salamander (s.l.)
Yellow-spotted Salamander
Red-backed Salamander

American Toad

Spring Peeper
Tetraploid Gray Tree Frog
Midland Chorus Frog
Woodfrog
Northern Leopard Frog
Green Frog

Snapping Turtle (newly emerged hatching found on swimming beach)
Eastern Painted Turtle

Eastern Garter Snake
Norther Water Snake
Northern Redbelly Snake
Eastern Smooth Green Snake
Eastern Milk Snake

³ Data on sites, numbers, habitat, etc. are filed with the Ontario Herptofaunal Survey.

APPENDIX 5: AREA OF NATURAL AND SCIENTIFIC INTEREST - LIFE SCIENCE CHECKSHEET

Name	Map Name	Map Number	UTM Ref.
Warsaw Caves ANSI	Peterborough	31 D/8	28E260

County, District or Regional Municipality (s)	Latitude	Longitude	Alt.	Min.	Max.
Peterborough County	44° 27'	78° 07'		213m	243m

Locality on Indian River north of Warsaw village Area ca. 270 ha.

Township(s) Dummer Township 1:50,000 NTS Map Showing Area Boundaries

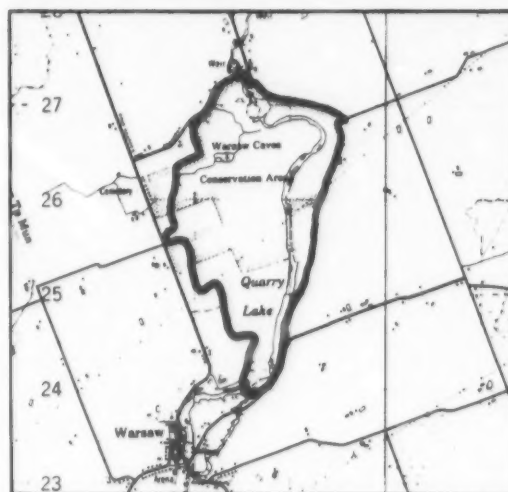
Ownership Crown and private

Administration Otonabee Region Conservation Authority

Site Region and District	MNR Region and District
6-9	Central (Lindsay)

Aerial Photographs

Year	Roll	Flight Line	Numbers
1978	121	4431	57-59
1978	138	4432	161-162



Physical and Biological Features

The site is situated on thin glacial moraine deposits (the Dummer Moraine) over sedimentary limestone bedrock which outcrops throughout the site, forming cliffs, woodland ridges and limestone flats. The flats are superficially like alvar meadows but are not spring flooded and are too dry. They do support some alvar flora, however. The forest in deeper soil is commonly dominated by White Cedar, Balsam Fir, White Spruce and White Pine. On a deep ice-contact deposit (either an esker remnant or drumlin) mature and submature Sugar Maple forest has developed.

A glacial spillway of the Kirkfield outlet flowed along the Indian River at one time; the presence

(Cont'd)

Major Information Sources

K. M. LINDSAY. 1986. Life Science Areas of Natural and Scientific Interest in Site District 6-9. Parks and Recreation Areas Section, Central Region, Ontario Ministry of Natural Resources, Richmond Hill; D. F. BRUNTON. 1990. A Biological Inventory of the Warsaw Caves Area of Natural and Scientific Interest, Peterborough County, Ontario. Parks and Recreation Areas Section, Ontario Ministry of Natural Resources, Central Region, Richmond Hill.

Evaluation and Priorities

Provincially Significant karst & spillway landscape, with regionally significant Sugar Maple forest

Date Compiled

July 1990

Compiler

Daniel F. Brunton

Ontario Ministry of Natural Resources, Parks and Recreation Areas Section, Aurora, Ontario L4G 3G8

of the Provincially Significant Smooth Woodsia (*Woodsia glabella*) fern on shaded, cedar-covered cliffs along the river is apparently a relict attributable to the subarctic conditions present at that time.

Fen-like shore meadows occupy narrow strips along the Indian River in the central portion of the study area and support a variety of unusual and locally/regionally significant flora. They have apparently adapted to the artificially maintained water level of Quarry Lake and the Indian River effected by the weir at Warsaw.

A rich complex of karst features, including solution-holes, caves and underground channels provides a diversity of natural situations in the ANSI. This is reflected in a diverse calcicolous vascular flora of over 370 species.

The Warsaw Caves themselves are known as roosting sites for several species of bats; the uncommon Keen's Bat and Eastern Pipistrelle have been reported here, although the full potential of this element is unclear.

The corridor along the Indian River containing the most extensive cliff and woodland ridge complexes, the fen-like meadows and locally interesting deciduous swamp forest, is in relatively natural condition and supports a high concentration of rare species and significant vegetation types. Most upland landscape areas have been noticeably disturbed by human activity.

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